Academic Regulations

Program structure & Detailed Syllabus

2017

For

Under Graduate Programme (B.Tech)

ELECTRICAL AND ELECTRONICS ENGINEERING

(Applicable For Batches Admitted From 2017 – 2018)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY
(AUTONOMOUS)

DUVVADA - VISAKHAPATNAM – 530 049

(An Autonomous Institute, Accredited by NAAC, Affiliated to JNTUK, Kakinada, AP)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY

(AUTONOMOUS)

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ACADEMIC REGULATIONS

(VR 17)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY (AUTONOMOUS)
VISAKHAPATNAM

ACADEMIC REGULATIONS for B. Tech. (Regular)

(Applicable for the batches admitted 2017-18 onwards)

The Admission of students into B. Tech. course shall be as per the Govt. of Andhra Pradesh rules.

1. Award of B. Tech. Degree

A student will be declared eligible for the award of the B. Tech. degree if he/she fulfils the following academic regulations.

a. Pursue a program of study for not less than four academic years and not more than eight academic years.
b. For lateral entry scheme admission: Pursue a program of study for not less than three academic years and not more than six academic years.
c. For the award of a degree, regular candidate has to register for 189 credits and shall secure 189 credits.
d. Lateral entry candidate has to register for all the courses from second year onwards and secure all the credits registered for.

2. Courses of Study

The following courses of study are offered at present for specialization in the B. Tech. Course.

S. No.	Course Code	Programme & Abbreviation
01	01	Civil Engineering (CE)
02	02	Electrical and Electronics Engineering (EEE)
03	03	Mechanical Engineering (ME)
04	04	Electronics and Communication Engineering (ECE)
05	05	Computer Science and Engineering (CSE)
06	12	Information Technology (IT)
07	19	Electronics and Computer Engineering (E.Com E)

And any other Course as approved by the authorities of the Institute from time to time.

3. Registration: A student shall register for courses in each semester as per the courses offered by the concerned department.

4. Curricular Program

The Curriculum of the four-year B. Tech Course has been designed to achieve a healthy balance between theory & lab hours, industry experience and to develop technical skills required for a career in the industry or a career in research**.**

5. Distribution and Weightage of Marks

i. The performance of a student in each semester shall be evaluated Subject-wise with a maximum of 100 marks for theory courses and 100 marks for practical course. The project work shall be evaluated for 200 marks.

ii. For theory course the distribution shall be 40 marks for Internal Evaluation and 60 marks for the End Semester Examinations.

Distribution of marks for theory course, practical course and Design/Drawing is detailed below:

5.1. Internal 40 marks for theory course shall be awarded as follows:

i) 25 marks for MID exams
ii) 10 marks for continuous assessment
iii) 5 marks for Attendance

MID marks shall be calculated with 80% weightage for best of the two MIDs and 20% weightage for other MID exam.

5.2. For practical courses (Laboratory): There shall be continuous evaluation during the semester. Each Lab exam is evaluated for 100 marks. 50 marks shall be awarded for internal examination and 50 marks shall be awarded for external examinations.

5.2.1. Internal marks shall be awarded as follows

i) Day to day assessment– 20 Marks
ii) Record – 10 Marks
iii) Internal laboratory exam– 20 Marks

5.2.2.The semester end examinations shall be conducted by the teacher concerned and external examiner

5.3. For the courses having design and/or drawing, (Such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 40 marks for internal evaluation.

5.3.1. Internal marks shall be awarded as follows:

i) 20 marks for Day-to-day assessment
ii) 15 marks for internal exam
iii) 5 marks for Attendance

There shall be two internal examinations in a semester and the internal marks shall be calculated with 80% weightage for best of the two internals and 20% weightage for other internal exam.
5.3.2. External examination shall be conducted for 60 marks.

5.4. Industrial Visit: The industrial visit shall be carried out in their domain during the summer vacation after the second year second semester. A student has to submit a report which will be evaluated for 100 marks and will be submitted to an internal evaluation committee comprising Head of the Department or his / her nominee and two senior faculty of the department including the industrial visits coordinator/ supervisor.

5.5. Industry- Oriented Mini Project: The Industry oriented mini project is carried out during the third year second semester vacation. The students have an option to choose their own area of interest which may be related to the course work. Mini project report is evaluated for 100 marks in fourth year first semester before the first mid-term exam. Assessment is done by the supervisor /guide for 40 marks based on the work and mini project report. The remaining 60 marks are allocated for presentation by the student to a committee comprising of the project supervisor and senior faculties members nominated by Head of the Department.

5.6. MOOCs: It is an online course (Minimum of 12 weeks) to promote advanced knowledge suitable for placement and research.

To award credits, the student should get certificate after they have registered for written exam and successfully passed

(Or)

College will conduct the written examination/Viva-voce and award the credits and grades.

In case a student fails in any online course, he/she may be permitted to register for the same course or an alternate course decided by the department committee. The internal marks secured earlier will be nullified if the course is changed. The assessment procedure of MOOCs course remains same as general theory course.

Note: The registered course must not be same as any of the courses listed in the program structure of their regulation till final year including electives.

5.7. Technical Seminar: For Technical seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his/her understanding over the topic, and submit to the department, which shall be evaluated by the Departmental Committee consisting of Head of the Department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for seminar.

5.8. Comprehensive Viva: The Comprehensive Viva aims to assess the students' understanding in various subjects he / she studied during the B.Tech course of study. Comprehensive Viva is conducted for a total of 50 marks. It shall be conducted in IV Year II Semester. The Comprehensive Viva–Voce will be conducted by a Committee consisting of Head of the Department, two senior faculty members of the Department and External Expert.

5.9. Internship: Internships help students to acquire in depth knowledge about a particular topic related to the program of study. Such extensive work is expected to create a platform for a job or further research in the chosen area. Interested students may opt for a full semester Internship during the fourth year second semester. Such students shall be exempted for equivalent theory course credits during that semester and the corresponding credits are awarded through the Internship. A self-study report, duly authorized by the industry supervisor / guide, shall be submitted at the end of the fourth year second semester. Internship report is evaluated for 400 marks in total. Internal assessment is done by the academic supervisor/guide for 100 marks based on the work and presentation of the internship report. The assessment for 300 marks is evaluated and awarded by a panel of members consisting of Head of the Department, Senior Faculty and Industry Expert.

5.10. Main Project: Out of total 200 marks for the project work, 80 marks shall be for Internal Evaluation and 120 marks for the external assessment. The Internal Evaluation shall be on the basis of two mid-term project reviews conducted during the progress of the project. The End Semester Examination (Viva-Voce) shall be conducted by the committee consists of an External Examiner,

Head of the Department (internal examiner) and a senior faculty of the Department. The evaluation of project work shall be conducted at the end of the IV year.

5.11. Audit courses: All audit courses will be "Pass/Fail" type with no credit points allotted. The result of the student in the audit course will be notified in the marks memo. A student must pass all the audit courses registered to be eligible for the award of B. Tech. degree.

List of audit courses will be notified from time to time. An indicative list of courses is as shown below.

a) Professional Ethics & Human Values b) Any Foreign Language c) Journalism d) Finance e) Legal Sciences f) Social Sciences g) English for Special Purposes h) Fine Arts i) Clinical Psychology j) Intellectual Property Rights & Patents etc.

6. Attendance Requirements:

6.1. It is desirable for a candidate to have 100% attendance in the class in all the courses. However, a candidate shall be permitted to appear for the end semester examination if he/she has a minimum of 75% aggregate attendance in the semester. Student will not be permitted to write Mid examination if the attendance percentage is less than 75 % during the stipulated instruction duration. However, Academic Monitoring Committee shall review the situation and take appropriate decision.
Note: Special cases for students having extraordinary performance at National and International level will be considered by the Academic monitoring committee.

6.2. Condonation of shortage of attendance may be considered on Medical grounds maximum up to 10%, if the student provides the medical certificate to the HOD immediately after he / she recovers from the illness. Medical Certificate submitted afterwards shall not be permitted. Shortage of attendance equal to or above 65% and below 75%will be condoned on payment of fee as fixed by the competent authority and the student concerned will be permitted to take the end semester examination. ***This privilege is given only three times for regular student and only two times for lateral entry student during the entire program of study***.

6.3. Shortage of attendance may be considered for the students who participate in prestigious sports, co and extra-curricular activities if their attendance is in the minimum prescribed limit.

6.4. A student will be promoted to the next semester if satisfies attendance and credits requirement.

7. Academic Requirements:

The following academic requirements have to be satisfied in addition to the attendance requirements.

For any course, student is considered to be passed upon securing minimum 35% marks in the external examination alone and minimum 50% marks from both internal and external examination put together

8. Promotion Policy:

To promote to III year, a student has to secure minimum 50% of total credits from I & II-year courses
To promote to IV year, a student has to secure minimum 50% of total credits from I, II & III-year courses

In case of Lateral entry students, to promote to IV year, a student has to secure minimum 50% of total credits from II & III-year courses

9. Supplementary examinations: Supplementary examinations for the odd Semester shall be conducted with the regular examinations of even semester and vice versa. In case a student fails in online courses/ industrial lecture(s), he/she may be permitted to register for another course/lecture(s).

10. Examinations and Evaluation

10.1. General guidelines

i. All the semester end examinations are conducted for duration of three hours
ii. External examination shall be conducted for 60 marks consist of five questions of internal choice carrying 12 marks each.
iii. For laboratory examinations, the evaluation is done by internal examiner and one external examiner.

10.2. Revaluation

There is a provision for revaluation of theory courses if student fulfils the following norms.

The request for revaluation must be made in the prescribed format duly recommended by the Chief Superintendent of Examinations through Additional Controller along with the prescribed revaluation fee.

11. Grading System:
CGPA

Marks Range (in %)	Letter Grade	Level	Grade Point
≥ 90	O	Outstanding	10
≥80 to <90	A	Excellent	9
≥70 to <80	B	Very Good	8
≥60 to <70	C	Good	7
≥50 to <60	D	Satisfactory	6
<50	F	Fail	0
		Absent	-1
		Withheld	-2
		Malpractice	-3

Computation of SGPA

The following procedure is to be adopted to compute the Semester Grade Point Average. (SGPA) and Cumulative Grade Point Average (CGPA):

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = Σ(Ci x Gi) / ΣCi

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th}course.

Computation of CGPA

- The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \Sigma(Ci \times Si) / \Sigma Ci$$

Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.

- Equivalent Percentage = (CGPA – 0.75) X 10

12. Award of Class

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he/she shall be placed in one of the following three classes:

Class Awarded	CGPA to be secured	
First Class with Distinction	≥ 7.75 without course failures during entire duration of study	**CGPA secured from 189 Credits.**
First Class	≥ 6.75 to <7.75	
Second Class	≥ 5.75 to < 6.75	

13. General Instructions

i. Where the words 'he', 'him', 'his', occur, they imply 'she', 'her', 'hers', also.

ii. The academic regulations should be read as a whole for the purpose of any interpretation.

iii. In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman, Academic Council is final.

iv. The college may change or amend the academic regulations or syllabi from time to time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Institution.

14. Transitory Regulations

i. The student has to continue the course work along with the regular students of the respective semester in which the student gets re-admission.

ii. The student has to register for Substitute / Compulsory courses offered in place of courses studied earlier.

iii. The mode of internal evaluation and end-semester examinations shall be on par with the regular students, i.e., the student has to follow the mode of internal evaluation and the then question paper model for the end-semester examinations along with the regular students of the respective semester in which the student gets re-admission. The marks secured in the internal and end-semester examinations will be pro-rated in accordance with the regulations under which the student was first admitted.

iv. For the courses studied under earlier regulations but failed, the student has to appear, pass and acquire credits from the supplementary examinations as and when conducted. The question paper model shall remain same as the one in which the student took examination during previous regulations.

v. The promotion criteria based on attendance as well as credits shall be in accordance with the regulations under which the student was first admitted.

vi. All other academic requirements shall be in accordance with the regulations under which the student was first admitted.

vii. The decision of the Principal is final on any other clarification in this regard.

viii. Transcripts: After successful completion of the entire program of study, a transcript containing performance of all academic years will be issued as a final record. Partial transcript will also be issued up to any point of study to a student on request, after payment of requisite fee.

15. Minimum Instruction Days

The minimum instruction days for each semester shall be 16 weeks

There shall be no branch transfers after the completion of the admission process.

16. Withholding of Results

If the student has not paid the dues, if any, to the Institute or in any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

Note: All other regulations including attendance requirements related to four year B. Tech Regular program will be applicable for B.Tech. Lateral Entry Scheme

17. Malpractices Rules

DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

S.No	Nature of Malpractices/ Improper conduct	Punishment
1 (a)	If the candidate possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course only.
(b)	If the candidate gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	If the candidate has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester/year. The Hall Ticket of the candidate is to be

		cancelled.
3	If the candidate impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4	If the candidate smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	If the candidate uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course.
6	If the candidate refuses to obey the orders of the Chief Superintendent/Assistant - Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation,	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against

	assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	them.
7	If the candidate leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	If the candidate possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the college, expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and. a police case will be registered against them.
10	If the candidate comes in a drunken	Expulsion from the examination hall and cancellation of the performance in that course

	condition to the examination hall.	and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that course and all other courses the candidate has appeared including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Academic committee of the Institute for further action to award suitable punishment.	

18. UGC RECOMMENDED PUNISHMENT FOR RAGGING

i. Suspension from attending classes and academic privileges
ii. Withholding/withdrawing scholarships/fellowship and other benefits.
iii. Debarring from appearing in any test/examination or other evaluation process
iv. Withholding results
v. Debarring from representing the institution in any regional, national or international meet, tournament, youth festival etc.
vi. Suspension/expulsion from the hostel
vii. Cancellation of admission
viii. Rustication from the institution for period ranging from 1 to 4 semesters.
ix. Expulsion from the institution and consequent debarring from admission to any other institution for a specified period.
x. Fine may extend up to Rs. 2.5 lakh.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
PROGRAM STRUCTURE (VR 17)

I Year- I Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1000171101	English- I	3	0	0	3
2	1000171102	Engineering Mathematics-I	3	1	0	3
3	1000171105	Computer Programming using C	3	1	0	3
4	1000171106	Engineering Drawing	3	1	0	3
5	1000171107	Applied Physics	3	1	0	3
6	1000171112	Environmental Studies	3	0	0	3
7	1000171121	English-Communication Skills Laboratory - I	0	0	3	2
8	1000171122	Engineering Physics Laboratory	0	0	3	2
9	1000171128	Computer Programming Laboratory	0	0	3	2
				Total Credits		**24**

I Year – II Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1000171201	English-II	3	0	0	3
2	1000171202	Engineering Mathematics-II	3	1	0	3
3	1000171203	Engineering Mathematics-III	3	1	0	3
4	1000171208	Electrical Circuit Analysis - I	3	1	0	3
5	1000171211	Applied Chemistry	3	1	0	3
6	1000171216	Engineering Mechanics	3	1	0	3
7	1000171221	English Communication Skills Lab-2	0	0	3	2
8	1000171224	Engineering Workshop	0	0	3	2
9	1000171227	Engineering Chemistry Laboratory	0	0	3	2
				Total Credits		**24**

II B.Tech **I Semester**

S.No	Course Code	Course Title	L	T	P	Credits
1	1002172101	Electrical Circuit Analysis – II	3	1	0	3
2	1002172102	Electrical Machines-I	3	1	0	3
3	1002172103	Basic Electronic Devices &Circuits	3	1	0	3
4	1002172104	Electro Magnetic Fields	3	1	0	3
5	1002172105	Thermal and Hydro Prime movers	3	1	0	3
6	1002172121	Electrical Circuits Laboratory	0	0	3	2
7	1002172122	Electrical Machines -I Laboratory	0	0	3	2
8	1002172123	Hydraulic Machinery lab	0	0	3	2
Total Credits:						**21**

II B.Tech **II Semester**

S.No	Course Code	Course Title	L	T	P	Credits
1	1002172201	Electrical Machines-II	3	1	0	3
2	1002172202	Control Systems	3	1	0	3
3	1002172203	Power Generation Engineering & Economics	3	1	0	3
4	1002172204	Analog Electronics	3	1	0	3
5	1002172205	Data Structures	3	1	0	3
6	1099172106	Managerial Economics & Financial Analysis	3	1	0	3
7	1002172221	Electrical Machines –II Laboratory	0	0	3	2
8	1002172222	Electronic Devices & Circuits Laboratory	0	0	3	2
9	1002172231	Industrial visit	0	0	0	2
Total Credits:						**24**

III B.Tech **I Semester**

S.No	Course Code	Course Title	L	T	P	Credits
1	1002173101	Power transmission Engineering	3	1*	0	3
2	1002173102	Signals and Systems	3	1*	0	3
3	1002173104	Electrical Measurements	3	1*	0	3
4	1099172203	Management Science	3	1*	0	3
5	1002173105	Power Electronics	3	1*	0	3
6	1002173106	Digital Electronics	3	1*	0	3
7	1002173121	Power Electronics Lab	0	0	3	2
8	1002173122	Control Systems Lab	0	0	3	2
9	1002173123	Data Structures Lab	0	0	3	2
Total Credits:						24

III B.Tech II Semester

S.No	Course Code	Course Title	L	T	P	Credits
1	1002173201	Power Electronic Controllers &Drives	3	1*	0	3
2	1002173202	Power System Analysis	3	1*	0	3
3	1002173203	Renewable Energy Systems	3	1*	0	3
4	1002173204	Microprocessors and Microcontrollers (MPMC)	3	1*	0	3
5	**Elective – I:**		3	1*	0	3
	1002173205	1.Electric Vehicles				
	1002173206	2.Optimization Techniques				
	1002173207	3.Instrumentation				
	1002173208	4.Special Electrical Machines				
6	**Open Elective – I:**		3	1*	0	3
	1005173207	1.Introduction to Python Programming				
	1003173203	2.Robotics				
	1002173209	3.Neural Networks & Fuzzy Logic				
	1002173210	4.Energy Audit and conservation & Management				

7	1002173221	Electrical Measurements Lab	0	0	3	2
8	1002173222	Microprocessors and Microcontrollers (MPMC) Lab	0	0	3	2
9	1099172103	Professional Ethics & Human Values	2	0	0	0
Total Credits:						**22**

S. No	Course Code	Course Title	L	T	P	Credits
1	1002173241	Industry Oriented Mini Project	0	0	0	2

IV B.Tech **I-Semester**

S. No	Course Code	Course Title	L	T	P	Credits
1	1002174101	Utilization of Electrical Energy	3	1	0	3
2	1002174102	Programmable Logic Controller	3	1	0	3
3	1002174103	Power System Operation & Control	3	1	0	3
4	1002174104	Switchgear and Protection	3	1	0	3
5	**Elective – II:**					
	1002174105	1. Distributed Generation and Micro grids	3	1	0	3
	1002174106	2. Advanced Control Systems				
	1004174105	3. IoT & its Applications				
6	**Open Elective-II:** /MOOCs					
	1005172104	1. Java Programming	3	1	0	3
	1005172201	2. Data Base Management Systems				
	1004173203	3. VLSI Design				
	1099173201	4. Entrepreneurship Development				
7	1002174121	Electrical Simulation Lab	0	0	3	2
8	1002174122	Power Systems & Simulation Lab	0	0	3	2
9	1099173101	IPR & Patents	2	0	0	0
Total Credits :						**22**

IV B.Tech II- Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1002174201	Digital Control Systems	3	1	0	3
2	1002174202	HVDC Transmission	3	1	0	3
3	1002174203	Electrical Distribution Systems	3	1	0	3
4	**Elective – III:**					
	1002174204	1. Smart Grid Technologies	3	1	0	3
	1002174205	2. Flexible Alternating Current Transmission Systems				
	1002174206	3. Power System Reforms				
	1002174207	4. Condition Monitoring of Electrical Equipments				
(or)						
1002174281		Internship	0	0	0	12
5	1002174251	Technical Seminar	0	3	0	2
6	1002174261	Comprehensive Viva	0	0	0	2
7	1002174231	Main Project	0	0	0	10
		Total Credits :				**26**

Grand Total of credits= 24+24+21+24+24+24+22+26=189

PROGRAM STRUCTURE

FOR

I B.TECH

I &II SEMESTERS

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
PROGRAM STRUCTURE (VR 17)

I Year- I Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1000171101	English- I	3	0	0	3
2	1000171102	Engineering Mathematics-I	3	1	0	3
3	1000171105	Computer Programming using C	3	1	0	3
4	1000171106	Engineering Drawing	3	1	0	3
5	1000171107	Applied Physics	3	1	0	3
6	1000171112	Environmental Studies	3	0	0	3
7	1000171121	English-Communication Skills Laboratory - I	0	0	3	2
8	1000171122	Engineering Physics Laboratory	0	0	3	2
9	1000171128	Computer Programming Laboratory	0	0	3	2
				Total Credits		**24**

I Year – II Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1000171201	English-II	3	0	0	3
2	1000171202	Engineering Mathematics-II	3	1	0	3
3	1000171203	Engineering Mathematics-III	3	1	0	3
4	1000171208	Electrical Circuit Analysis - I	3	1	0	3
5	1000171211	Applied Chemistry	3	1	0	3
6	1000171216	Engineering Mechanics	3	1	0	3
7	1000171221	English Communication Skills Lab-2	0	0	3	2
8	1000171224	Engineering Workshop	0	0	3	2
9	1000171227	Engineering Chemistry Laboratory	0	0	3	2
				Total Credits		**24**

DETAILED SYLLABUS

FOR

I B.TECH

I SEMESTERS

Course Code		L	T	P	Credits
1000171101	ENGLISH – I	3	0	0	3

Course Objectives

- To improve the language proficiency of the students in English with emphasis on LSRW skills.
- To enable the students to study and comprehend the prescribed lessons and subjects more effectively related to their theoretical and practical components.
- To develop the communication skills of the students in both formal and informal situations.
- Practice critical thinking to develop innovative and well-founded perspectives related to the students' emphases. Build and maintain healthy and effective relationships.
- To convey a credible message and create concise messages using a structured writing process.
- To develop effective interpersonal communication skills.

Course Outcomes

After completing this Course, the student should be able to:

- Use English language, both written and spoken, competently and correctly.
- Improve comprehension and fluency of speech.
- Gain confidence in using English in verbal situations.
- Display competence in oral, written, and visual communication.
- Communicate ethically.
- Demonstrate positive group communication exchanges.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Enhance English Language by relating the ideas of eminent personalities.	Understanding	PO6,PO9, PO10, PO12
CO2	Articulate the technological advancements fluently. .	Applying	PO10, PO12
CO3	Inculcate the art of thinking and writing clearly and logically. .	Applying	PO10, PO12
CO4	Enact various themes through team work and learn the usage of vocabulary through humourous texts.	Analyzing	PO10, PO12

Detailed Text: English Essentials

1. **In London**-M. K.Gandhi
2. **The Knowledge Society** - A. P. J. Abdul Kalam
3. **Principles of Good Writing -** L. A.Hill
4. **Man's Peril –** Bertrand Russell
5. **Luck –** Mark Twain

Non-Detailed Text: Panorama

1. **War** – Luigi Pirandello
2. **The Verger** – Somerset Maugham

PRESCRIBED TEXTBOOKS:

1. **English Essentials** by Ravindra Publishing House
2. **Panorama** by Oxford University Press

SUGGESTED TEXT BOOKS:

1. **You Can Win** by Shiv Khera
2. **English for Engineers and Technologists** by Orient Black Swan
3. **Objective English** by R. S. Agarwal,S.Chand.co

REFERENCE BOOKS:

1. "Practical English Usage" by Michael Swan, 3rd Edition,OUP.
2. "Intermediate English Grammar" by Raymond Murphy,CUP.
3. "Study: Reading" by Eric H .Glendinning, 2ndEditionCUP.
4. "Business Correspondence and Report writing" by R.C Sharma, Tata McGrawhill

Course Code		L	T	P	Credits
1000171102	**ENGINEERING MATHEMATICS-I**	3	1	0	3

Course Overview:

This course deals with differential equations and its application with more focus on advanced Engineering Mathematics. This course helps the students to learn relevant mathematical tools which are required in the analysis of problems in engineering and scientific professions. Topics included in this course are differential equations of first order and their applications, higher order linear differential equations and their applications, functions of single variable and their applications and multiple integrals, Laplace transforms and their applications. The mathematical skills derived from this course form a necessary base for analytical and design concepts encountered in the program.

Course Objectives:

1. To explain mathematical modeling with the knowledge of differential equations.
2. To discuss higher order differential equations and its applications to solve engineering problems.
3. To evaluate maxima and minima of function of several variables.

Course Outcomes:

1. Solve basic engineering problems described by first order differential equations.
2. Determine solutions to higher order linear homogeneous and non homogeneous differential equations with constant coefficients.
3. Apply the techniques of multivariable differential calculus to determine extreme and series expansions etc. of functions of several variables.
4. Extend the concept of integration to two and three dimensions and support it through applications in engineering mechanics.
5. Appraise the Laplace transform technique and use it to solve various engineering problems.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Solve linear differential equations of first and higher order.	Understanding	PO1, PO2, PO3, PO12
CO2	Determine extrema and series expansions of functions of several variables.	Applying	PO1, PO2, PO4, PO12
CO3	Determine double integral, triple integral to find area and volume..	Applying	PO1, PO2, PO3, PO12
CO4	Appraise Laplace transform to solve various engineering problems.	Analyzing	PO1, PO2, PO12

UNIT-I :

MEAN VALUE THEOREMS:

Mean Value Theorems - Rolle's Theorem - Lagrange's mean value theorem – Cauchy's mean value theorem (without proofs)

ORDINARY DIFFERENTIAL EQUATIONS:

Exact equations and equations reducible to exact form- Linear equations- Bernoulli's equation.

Applications: Orthogonal trajectories ,Simple Electric Circuits

UNIT-II:

LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER:

Linear differential equations of second and higher order with constant coefficients, Non-homogeneous term of the type $Q(x)=e^{ax}$,sinax,cosax,x^n,$e^{ax}V(x)$,$x^nV(x)$- Method of variation of parameters.

Applications: LCR Circuits

UNIT-III:

FUNCTIONS OF SEVERAL VARIABLES:

Functions of several variables – Partial Differentiation –Euler's Theorem-Total Derivative – Change of variables - Jacobian -Functional dependence – Taylors theorem for functions of two variables.

Applications: Maxima and Minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT-IV:

MULTIPLE INTEGRALS: Introduction: Review of Coordinate Systems (Cartesian, Polar, Parametric, Spherical, Cylindrical) -multiple integrals - double and triple integrals – change of variables – Change of order of Integration.

Applications: Areas and Volumes of Simple curves (Cartesian)

UNIT-V :

LAPLACE TRANSFORMS:

Introduction - Laplace transforms of standard functions – Shifting Theorems - Transforms of derivatives and integrals - multiplication by t^n- division by t – Unit step function –Dirac delta function. Laplace transform of Periodic functions. Introduction - Inverse Laplace transforms– Properties- Convolution theorem (without proof).

Applications: Solution of ordinary differential equation with constant coefficients Initial Value Problems) using Laplace transforms.

TEXT BOOKS:

1. Higher Engineering Mathematics – 43rd Edition by Dr. B. S. Grewal, Khanna Publishers, New Delhi.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreszig, 8thEd, Wiley StudentEd.

2. Engineering Mathematics, Greenburg, 2nd Ed, Pearsoneducation.

3. A Text book of Engineering Mathematics, N.P.Bali, Laxmi Publications (P) Ltd.

4. Advanced Engineering Mathematics, B. V. RamanaTataMcGrawHill Publishing Co.Ltd.

5. Engineering Mathematics, P.Sivaramakrishna Das, C.Vijayakumari ,2017Pearson Education ServicesPvt.Ltd

Course Code		L	T	P	Credits
1000171105	COMPUTER PROGRAMMING USING C	3	1	0	3

Course Objectives:

- Understanding the basics of the computers and background.
- Drawing flowcharts and Formulating algorithmic solutions to problems and implementing in C language.
- Understanding branching, iteration and data representation using arrays.
- Modular programming and recursive solution formulation.
- Understanding pointers and dynamic memory allocation.

Course Prerequisites:

Students should have knowledge of

- Basics of Computer Components.
- Distinction between software and hardware.

Course Outcomes:

Students will be able to:

- Understand the fundamentals of computers, solving the problems using flow charts, algorithms and pseudo code.
- Write, compile and execute simple programs in C language.
- Use different data types and operators in Clanguage.
- Design programs involving decision structures, loops, functions and passing parameters to functions.
- Develop programs using arrays, structures and pointers.
- Understand the dynamic memory allocation functions using pointers.
- Understand the basics of file operations, reading, writing and updating the files.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Write compile and debug Programs in C language	Understand	PO1, PO2, PO3
CO2	Use operators, data types and write programs	Understand	PO1,PO2
CO3	Select the best loop construct for a given problem	Analyzing	PO3,PO5
CO4	Design and implement C programs	Analyzing	PO1,PO2 PO3,PO4, PO12

UNIT-I

Computer Basics – What is a computer, History of computers, Characteristics of computers, Classification of computers, Applications of computers, Components and functions of a Computer System: hardware and software concept, input/output devices, memory concept and secondary memories, Number System, Computer languages, Flow Charts, algorithms and pseudocode.

Introduction to C programming- Background and characteristics of C, Structure of a C Program, Input/Output Statements in C, writing C programs, compiling and executing C programs.

UNIT-II

Programming Style – Tokens of C, Keywords, Variables, Constants and rules to form variables and constants, Data Types, Declaration of Variables and initialization, Operators, Expression Types, Operator Precedence and Associativity. Implicit Type Conversions, Explicit Type Conversions (Casts), Assignment Variations, Mathematical Library Functions, Interactive Input, Formatted Output, Format Modifiers.

Flow of Control:
Selection: if and if-else Statements, if-else if statement and switch case, nested if, examples.

Repetition and Unconditional Control Statements: Pretest and Posttest Loops, Counter-Controlled and Condition-Controlled Loops, while Statement, do while statement, for Statement, Nested Loops. Break, continue and go to statements.

UNIT-III

Modular Programming:

Function and Parameter Declarations: Function definition, types of functions, declaration and definition of user defined functions, its prototypes and parameters, calling a function. Function stubs and Functions with and without Parameters. Variable Scope, Variable Storage Class, Local Variable Storage Classes, Global Variable Storage Classes.

Parameter passing Techniques: Pass by Value, recursive functions.

UNIT-IV
Arrays and Strings

Arrays: One-Dimensional Arrays, Declaration, Array Initialization, Input and Output of Array Values, Arrays as Function Arguments, Two-Dimensional Arrays, linear search, and bubble sort.

Strings: String Fundamentals, String Input and Output, String manipulation functions, String Processing, String manipulation operations without Library Functions.

UNIT-V

Pointers, Structures and Unions, Data Files

Pointers: Concept of a Pointer, Initialization of pointer variables, pointers as function arguments, Dangling memory, address arithmetic, character pointers and functions, pointers to pointers, Pointers and arrays, Pointers and strings, Array of Pointers, Dynamic memory management functions, parameter passing by address, command line arguments.

Structures and Unions: Derived types, Structures declaration, Initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit-fields.

Data Files: Declaring, Opening, and Closing File Streams, Reading from and Writing to Text Files, Random File Access.

Text Books:

- ANSI C Programming, Gary J. Bronson, Cengage Learning.
- Programming in C, ReemaThareja, Oxford.
- Programming in C, Bl Juneja Anita Seth, Cengage Learning.

Reference Books:

- C Programming-A Problem Solving Approach, Forouzan, Gilberg, Cengage.
- Programming with C, Bichkar, Universities Press.
- The C Programming Language, Dennis Richie and Brian Kernighan, Pearson Education.
- C by Example, Noel Kalicharan, Cambridge.

Course Code		L	T	P	Credits
1000171106	**ENGINEERING DRAWING**	3	1	0	3

Objective: Engineering drawing being the principle method of communication for engineers, the objective to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

- To introduce the use and the application of drawing instruments and to make the students construct the polygons, curves and various types of scales. The student will be able to understand the need to enlarge or reduce the size of objects in representing them.
- To introduce orthographic projections and to project the points and lines parallel to one plane and inclined to other.
- To make the students draw the projections of the lines inclined to both the planes.
- To make the students draw the projections of the plane inclined to both the planes.
- To make the students draw the projections of the various types of solids in different positions inclined to one of the planes.
- To represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO number mapped
CO1	Understand the use of drawing instruments to construct the polygons and curves	Understanding	PO1,PO2,PO3
CO2	Learn the principle of orthographic projections. Draw Orthographic projections of points, lines.	Analyzing	PO1, PO2, PO3, PO12
CO3	Draw the various types of planes and solids its views in different Positions	Analyzing	PO1, PO2, PO3, PO12
CO4	Draw isometric views of simple objects	Analyzing	PO1, PO2, PO3, PO12

UNIT - I Polygons, Construction of regular polygons using given length of a side; Ellipse, arcs of circles and Oblong methods; Scales – Vernier and Diagonal scales.

UNIT - II Introduction to orthographic projections; projections of points; projections of straight lines parallel to both the planes; projections of straight lines – parallel to one plane and inclined to the otherplane.

UNIT- III Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclinations and traces.

UNIT - IV Projections of planes: regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT - V Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes. Conversion of isometric views to orthographic views; Conversion of orthographic views to isometricviews.

Text Books:

1. Engineering Drawing, N. D. Butt, Chariot Publications
2. Engineering Drawing, K. L. Narayana & P. Kannaiah, Scitech Publishers.
3. Engineering Graphics, P.I. Varghese, McGraw Hill Publishers

Reference Books:

1. Engineering Graphics for Degree, K. C. John, PHIPublishers
2. Engineering Drawing, Agarwal & Agarwal, Tata McGraw HillPublishers
3. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, NewAge

Course Code	APPLIED PHYSICS	L	T	P	Credits
1000171107		3	1	0	3

Course Objective:

- To enhance the fundamental knowledge in Physics and its applications relevant to various Streams of Engineering and Technology.

Learning Objectives:

- Impart Knowledge of Physical Optics phenomena like Interference, Diffraction and Polarization involving required to design instruments with higher resolution.
- Teach Concepts of coherent sources, its realization and utility optical instrumentation.
- Study the concepts regarding the bulk response of materials to the EM fields and their analytically study in the back-drop of basic quantum mechanics.
- Understand the physics of Semiconductors and their working mechanism for their utility in sensors.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe the wave phenomena and working principle of optical instruments.	Understanding	PO1,PO2, PO3, PO9, PO12
CO2	Apply the knowledge of basic quantum mechanics, to set up one-dimensional Schrodinger's wave equation.	Applying	PO1, PO2, PO9, PO12
CO3	Identify the importance of classical and quantum mechanical treatment of materials.	Applying	PO1, PO2, PO9, PO12
CO4	Make use of the basic concepts of energy bands in crystalline solids to understand semiconductor physics.	Analyzing	PO1, PO2, PO9, PO12

UNIT-I

INTERFERENCE: Principle of Superposition – Coherent Sources – Interference in thin films (reflection geometry) – Newton's rings – construction and basic principle of Interferometers.

UNIT-II

DIFFRACTION: Fraunhofer diffraction at single slit cases - Circular Aperture (Qualitative treatment only) - Grating equation - Resolving power of a grating, Telescope and Microscopes.

POLARIZATION: Types of Polarization – Double refraction - Quarter wave plate and Half Wave plate – Working principle of Polarimeter (Sacharimeter).

UNIT-III

ELECTROMAGNETIC FIELDS: Scalar and Vector Fields – Electric potential- Gradient, Divergence of fields – Gauss and Stokes theorems – Maxwell's equations in differential forms.

UNIT-IV

QUANTUM MECHANICS: Introduction – Matter waves – Schrodinger time independent and time dependent wave equations – Particle in a box.

FREE ELECTRON THEORY: Defect of classical free electron theory – density of states – Quantum free electron theory – concept of Fermienergy.

UNIT-V

BAND THEORY OF SOLIDS: Kronig- Penney model – energy bands in crystalline solids – classification of crystalline solids- effective mass of electron and concept of hole.

SEMICONDUCTOR PHYSICS: Conduction – Density of carriers in Intrinsic and Extrinsic- Semiconductors – Fermi energy in intrinsic and extrinsic semiconductors- Drift & Diffusion –Einstein's equation- Hall effect in semiconductors.

Outcome: Construction and working details of instruments, ie., Interferometer, Diffractometer and Polarimeter are learnt. Study EM-fields and semiconductors under the concepts of Quantum mechanics paves way for their optimal utility.

Text Books:

1. A Text book of Engineering Physics – by Dr. M.N.Avadhanuluand Dr. P.G.Kshira sagar, S.Chand & Company Ltd.,(2014)
2. Physics by David Halliday and Robert Resnick – Part I and PartII

Reference Books:

1. Applied Physics by P.K.Palanisamy, Scitech publications(2014)
2. Lasers and Non-Linear optics by B.B.Laud, New Age International Pub. (2008).
3. Engineering Physics by M. Arumugam, Anuradha Publication(2014)
4. Modern Engineering Physics by A.S.Vasudeva
5. University Physics by Young andFreedman
6. Engineering Physics by D.K.Bhattacharya and Poonam Tandon, Oxfordpress
7. Engineering Physics by R.K. Gaur and S.L.Gupta

Course Code		L	T	P	Credits
1000171112	**ENVIRONMENTAL STUDIES**	3	1	0	3

Course Overview: The course gives a broad view on the importance of environment and its conservation. It deals with distribution of biotic and abiotic components on the Earth, their over exploitation and its associated problems. It provides knowledge on different types of environmental pollutions and their control aspects. It develops practical orientation towards environmental concerns.

Course Objectives:

The objectives of the course are:

- Classify, describe and explain the concept of Ecosystems And Environmental Engineering.
- Overall understanding of different types of natural resources and its conservation.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impacts of developmental activities and the importance of Environmental Management.
- Awareness on the social issues, environmental legislations and global treaties.

Course Outcomes

- Give an outline of the natural resources and their importance for the sustenance of life and recognize the need to conserve the natural resources.
- Explain the concepts of the ecosystem and its function in the environment; explains the need for protecting the producers and consumers in various ecosystems and their role in the food web
- Elucidate the biodiversity of India and threats to biodiversity and conservation practices to protect the biodiversity
- Give a broad view on various attributes of pollution and their impacts and measures to reduce or control the pollution along with waste management practices.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Elucidate the natural resource & their importance for the sustenance of life and recognises the need to conserve natural resource	Level-2	PO2,PO5, PO6, PO7, PO12
CO2	Gives the broad view on the various attributes of pollution & and their impact & measure to reduce he pollution along with waste management	Level-3	PO2,PO3, PO5, PO6, PO7, PO12
CO3	Debates on social issues both rural and urban environment possible means to combat the challenges and trace the legislation of India towards sustainability	Level-3	PO1, PO2,PO5, PO6, PO7, PO12
CO4	Educates about Environmental Impact Assessment, Environmental Impact Statement & Environmental Audit	Level-4	PO1, PO2, PO4, PO5, PO6, PO7, PO12

UNIT – I: **Multidisciplinary nature of Environmental Studies & Natural Resource**

Definition, Scope and Importance of Environmental Engineering – Sustainability: Stockholm and Rio Summit–Global

Forest resources– Use and over– exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people

Water resources– Use and over utilization of surface and ground water– Floods, drought, conflict over water, dams– benefits and problems

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT – II : Environmental Pollution

Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies.

Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information Technology in Environment and human health.

Solid Waste Management: Sources, classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products.

UNIT – III: Social Issues and the Environment

Urban problems related to energy -Water conservation, rain water harvesting- Resettlement and rehabilitation of people; its problems and concerns.

Environmental ethics: Issues and possible solutions. Environmental Protection Act –Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act- Issues involved in enforcement of environmental legislation. –Public awareness.

UNIT – IV : Ecosystems, Biodiversity & Conservation Ecosystems:

Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. -Energy flow in the ecosystem -Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

Biodiversity and its conservation: Definition: Levels of Biodiversity, Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity -Threats to biodiversity: habitat loss, man-wildlife conflicts. -Endangered and endemic species of India – Conservation of biodiversity.

UNIT – V: Environmental Management and Field Studies

Impact Assessment and its significance various stages of EIA, Preparation of EMP and EIS, Environmental audit. Eco-tourism, Environmental Economics & Study of a Ecotourism spot in a local area, Visit to some Polluted site. Environmental diary.

Text Books:

1. Environmental Studies by R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
2. A Textbook of Environmental Studies by Shaashi Chawla, TMH, NewDelhi
3. Environmental Studies by P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education,Chennai

References:

1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers,Vijayawada
3. Environmental Studies by Benny Joseph, Tata McGraw Hill Co, NewDelhi
Environmental Studies by PiyushMalaviya, Pratibha Singh, Anoopsingh:Acme Learning, NewDelhi

Course Code		L	T	P	Credits
1000171121	**ENGLISH COMMUNICATION SKILLS LABORATORY-I**	0	0	3	2

Objectives: The Language Lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.

- To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
- To bring about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking.
- To improve the fluency in spoken English and neutralize mother tongue influence. To train students to use language appropriately to enhance Oratory Skills.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Demonstrate the usage of phonemes while referring to the dictionary	Understanding	PO5,PO9, PO10, PO12
CO2	Articulate with others by using proper functions.	Applying	PO5,PO9, PO10, PO12
CO3	Enact the roles with proper body language.	Applying	PO5,PO9, PO10, PO12
CO4	Communicate fluently with proper pronunciation	Analyzing	PO5,PO9, PO10, PO12

Unit -1: Letters and Sounds

Unit-2: Interaction 1

Unit-3: The Sounds of English

Unit-4: Interaction 2

PRESCRIBED LAB MANUAL:

Speak Well - Orient Black Swan Publishers

SUGGESTED BOOKS/ MANUALS AND SOFTWARES:

1. Interact - Orient Black Swan
2. Strengthen your Communication Skills by Maruthi Publishers

3. Personality Development and Soft Skills (Oxford University Press, New Delhi)
4. GRE-Barons-12th Edition
5. Objective English-R.S.Agarwal- S.Chand Publishers
6. The Rossettastone
7. English in Mind

Course Code	ENGINEERING PHYSICS LABORATORY	L	T	P	Credits
1000171122		0	0	3	2

Course Objectives:

- The Objective of this course is to make the students gain practical knowledge to co-relate with the theoretical studies. To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments.
- Design of circuits using new technology and latest components and to develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Experimentation of laws of vibrations in strenteched string	Understanding	PO1,PO2, PO9, PO12
CO2	Determination of velocity of sound, rigidity modulus of a wire, acceleration due to gravity, radius of gyration and Planck's constant.	Applying	PO1, PO2, PO9, PO12
CO3	Analyze the voltage vs. current characteristics of Zener diode and temperature vs. resistance characteristics of a thermistor	Applying	PO1, PO2, PO9
CO4	Demonstration of formation Newton's rings, diffraction pattern using grating and induced magnetic field in a cirucuclar coil.	Analyzing	PO1, PO2, PO9

List of Experiments

1. Determination of wavelength of a source-Diffraction Grating-Normal incidence
2. Newton's rings –Radius of Curvature of Plano-Convex Lens.
3. Determination of Rigidity modulus of a material- Torsional Pendulum.
4. Determination of Acceleration due to Gravity and Radius of Gyration-Compound Pendulum.

5. Melde's experiment – Transverse and Longitudinallmodes.
6. Verification of laws of stretched string –Sonometer.
7. Determination of velocity of sound – Volumeresonator.
8. L C R Senes Resonance Circuit
9. Study of I/V Characteristics of Semi conductor diode
10. I/V characteristics of Zenerdiode
11. Thermistor characteristics – Temperature Coefficient
12. Magnetic field along the axis of a current carrying coil – Stewartand Gee'sapparatus.
13. Determination of wavelength of laser source using dirreraction grating
14. Determination of Planck's constant using photocell

Course Code		L	T	P	Credits
1000171128	**COMPUTER PROGRAMMING LAB**	0	0	3	2

Learning Objectives:

- Understand the basic concept of C Programming, and its different modules that include conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures and File programming.
- Acquire knowledge about the basic concepts of writing a program in C language
- Demonstrate Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.
- Demonstrate Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.
- Demonstrate Role of Functions involving the idea of modularity.

Outcomes:

- Apply and practice logical ability to solve the problems.
- Understand C programming development environment, compiling, debugging, and linking and executing a program using the development environment
- Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs
- Understand and apply the in-built functions and customized functions for solving the problems.
- Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems.

Exercise - 1 Basics

a) What is an OS Command, Familiarization of Editors - vi,Emacs.
b) Using commands like mkdir, ls, cp, mv, cat, pwd, and man.
c) C Program to Perform Adding, Subtraction, Multiplication and Division of two numbers From Command line.

Exercise - 2 Basic Math

a) Write a C Program to Simulate 3 Laws at Motion
b) Write a C Program to convert Celsius to Fahrenheit and viceversa

Exercise - 3 Control Flow - I

a) Write a C Program to Find Whether the Given Year is a Leap Year ornot.
b) Write a C Program to Add Digits & Multiplication of anumber

Exercise – 4 Control Flow - II

a) Write a C Program to Find Whether the Given Numberis
   i) Prime Number
   ii) Armstrong Number
b) Write a C program to print FloydTriangle
c) Write a C Program to print PascalTriangle

Exercise – 5 Functions

a) Write a C Program demonstrating of parameter passing in Functionsand returning values.
b) Write a C Program illustrating Fibonacci, Factorial with Recursionwithout Recursion

Exercise – 6 Control Flow - III

a) Write a C Program to make a simple Calculator to Add, Subtract,Multiply or Divide Usingswitch…case
b) Write a C Program to convert decimal to binary and hex (using switchcall function thefunction)

Exercise – 7 Functions - Continued

Write a C Program to compute the values ofsin x and cos x and e^x values using Series expansion. (use factorial function)

Exercise – 8 Arrays Demonstration of
arrays

a) Search-Linear.
b) Sorting-Bubble,Selection.
c) Operations onMatrix.

Exercises - 9 Structures

a) Write a C Program to Store Information of a Movie UsingStructure
b) Write a C Program to Store Information Using Structures with Dynamically Memory Allocation c) Write a C Program to AddTwo Complex Numbers by Passing Structure to aFunction

Exercise - 10 Arrays and Pointers

a) Write a C Program to Access Elements of an Array UsingPointer
b) Write a C Program to find the sum of numbers with arrays andpointers.

Exercise – 11 Dynamic Memory Allocations

a) Write a C program to find sum of n elements entered by user. Toperform this

program, allocate memory dynamically using malloc ()function.

b) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function. Understand the difference between the above twoprograms

Exercise – 12 Strings

a) Implementation of string manipulation operations **with** libraryfunction.
   i) copy
   ii) concatenate
   iii) length
   iv) compare
b) Implementation of string manipulation operations **without** libraryfunction.
   i) copy
   ii) concatenate
   iii) length
   iv) compare

Exercise -13 Files

a) Write a C programming code to open a file and to print it contents onscreen.
b) Write a C program to copyfiles

Exercise - 14 Files (Continued)

a) Write a C program merges two files and stores their contents in anotherfile.
b) Write a C program to delete afile

Course Code		L	T	P	Credits
1000171201	**ENGLISH-II**	3	0	0	3

Course Objectives

- To improve the language proficiency of the students in English with emphasis on LSRW skills.
- To enable the students to study and comprehend the prescribed lessons and subjects more effectively related to their theoretical and practical components.
- To develop the communication skills of the students in both formal and informal situations.
- Practice critical thinking to develop innovative and well-founded perspectives related to the students' emphases. Build and maintain healthy and effective relationships.
- How to convey a credible message and create concise messages using a structured writing process.
- Develop effective interpersonal communication skills.

Course Outcomes

After completing this Course, the student should be able to:

- Use English language, both written and spoken, competently and correctly.
- Improve comprehension and fluency of speech.
- Gain confidence in using English in verbal situations.
- Display competence in oral, written, and visual communication.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Enhance English Language skills through the concept of Technological advancements.	Understanding	PO6,PO9, PO10, PO12
CO2	Illustrate the life of eminent personalities for developing the skills of vocabulary and grammar	Applying	PO10, PO12
CO3	Emphasize the relevance of cultures and traditions for enhancing writing skills through literature	Applying	PO10, PO12
CO4	Correlate the importance of Environment and sustainability with an emphasis on language skills	Analyzing	PO10, PO12

Detailed Text : English Encounters

1. **A Dilemma**- A Layman looks at Science
2. **Culture Shock**
3. **Lottery**
4. **Health Threats of Climate Change**
5. **A Chief Architect of Microsoft**

Non-Detailed Text: Panorama

1. **A Scarecrow** - Satyajit Ray
2. **A Village Lost to the Nation** - Krishna Chandra Pujari

Prescribed Books:

1. **English Encounters** by Maruthi Publications
2. **Panorama** by Oxford University Press

Course Code		L	T	P	Credits
1000171202	**ENGINEERING MATHEMATICS-II**	3	1	0	3

Course Overview:

The entire course material is divided into 5 modules covering duly recognized areas of theory and study. This course includes the topics of advanced Engineering Mathematics with more focus on the mathematical tools required to analyze the problems of Engineering & Scientific Professions. Some important topics of this course are Solutions of Algebraic and Transcendental Equations, Interpolation, Numerical integration and Numerical solution of ordinary differential equations, Fourier series and Fourier transforms. The main aim of this course is to provide a platform to the students to think, design, formulate and derive any problem encountered in real life situation.

Course Objectives:

1. To formulate and apply numerical techniques for root finding, interpolation.
2. To estimate definite integrals using Newton-Cotes quadrature formula.
3. To compute numerical solution of ordinary differential equations.
4. To determine the Fourier coefficients of a given function.
5. To analyze the characteristics and properties of Fourier transforms.

Course Outcomes:

Upon successful completion of this course, student will be able to:

1. Determine numerical solution of non Linear equation
2. Compute Interpolating polynomial for the given data
3. Explain Numerical Solution of ODE and Numerical Integration.
4. Construct Fourier series expansion of periodic functions
5. Determine Fourier transform, Fourier sine and cosine transform of function.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Determine numerical solution of non Linear equation	Understanding	PO1,PO2, PO12
CO2	Compute Interpolating polynomial for the given data	Applying	PO1, PO2,PO12
CO3	Explain Numerical Solution of ODE and Numerical Integration.	Applying	PO1, PO2, PO4, PO12
CO4	Construct Fourier series and Fourier transforms for functions	Analyzing	PO1, PO2, PO3, PO5, PO6, PO12

UNIT-I: SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS & INTRODUCTION TO FINITEDIFFERENCES:

Bisection method - Regula-falsi method - Iteration method - Newton-Raphson method. Finite differences: Forward, Backward and Central differences - Other difference operators and relations between them - Differences of a polynomial – To find missing terms.

UNIT-II: INTERPOLATION

Newton's forward interpolation, Newton's backward interpolation, Gauss Forward and Backward interpolation, Interpolation with unequal intervals – Newton's divided difference - Lagrange's interpolation.

UNIT-III: **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS AND NUMERICAL INTEGRATION**:

Single step methods: Taylor's series method –Picard's Method - Euler's and modified Euler's Methods - Fourth order Runge-Kutta method for solving first order equations. Numerical Integration: Trapezoidal Rule, Simpson's $1/3^{rd}$ Rule, Simpson's $3/8^{th}$ Rule

UNIT-IV: FOURIER SERIES:

Introduction- Determination of Fourier coefficients – Even and Odd functions – Change of interval– Half-range sine and cosine series-Practical Harmonic Analysis.

UNIT-V : FOURIER TRANSFORMS:

Fourier integral theorem (only statement) – Fourier sine and cosine integrals – Fourier transforms-Fourier Sine and Cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

TEXT BOOKS:

1. Higher Engineering Mathematics – 43rd Edition by Dr. B. S. Grewal, Khanna Publishers, New Delhi

REFERENCE BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreszig, 8thEd, Wiley Student Edition.
2. Engineering Mathematics, B.V.Ramana, Tata McGrawHill.
3. Mathematical Methods –Dr. Ravindranath & Dr. P. Vijaya Lakshmi, Himalaya Pub.
4. Engineering Mathematics, P.Sivaramakrishna Das, C.Vijayakumari , 2017Pearson Education Services Pvt.Ltd

Course Code		L	T	P	Credits
1000171203	**ENGINEERING MATHEMATICS-III**	3	1	0	3

Course Overview:

This course focuses on basic theoretical concepts and advanced Engineering Mathematics. This course helps the students to understand mathematical tools required in the analysis of problems in Engineering and Scientific Professions. The topics included are Solution for linear systems, Eigen values & Eigen vectors, linear transformations, partial differential equations, Vector integral theorems(Green's, Stoke's and Gauss's divergence theorems). Thus mathematical skills derived from this course enables the students to design and solve the problems.

Course Objectives:

1. To explain the concepts of matrix algebra and methods of solving system of linear equations.
2. To compute Eigen values and Eigen vectors of real and complex matrices.
3. To apply properties of partial differential equations to obtain solution for science and engineering problems.
4. To Classify and Solve partial differential equations
5. To generalize calculus to vector functions and to compute line, surface and volume integrals.

Course Outcomes:

Up on successful completion of this course, student will be able to:

1. Apply elementary transformations to reduce matrices to echelon form, normal form and hence find their rank.
2. Solve the system of linear equations and compute Eigen values and Eigen vectors of a square matrix.
3. Compute directional derivative and the gradient of functions of several variables.
4. Infer vector integral theorems to evaluate line, surface and volume integrals.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Solve simultaneous linear equations numerically using rank of a matrix and compute Eigen values and Eigen vectors of a square matrix.	Understanding	PO1,PO2, PO3, PO12
CO2	Identify/classify and solve partial differential equations.	Applying	PO1, PO2, PO3, PO6, PO8
CO3	Calculate gradient of a scalar function, divergence and curl of a vector function.	Applying	PO1, PO2, PO3, PO12
CO4	Determine line, surface and volume integrals using appropriate integral theorems.	Analyzing	PO1, PO2, PO6, PO12

UNIT-I: LINEAR SYSTEMS OF EQUATIONS:

Introduction-Rank-Echelon form-Normal form-Solution of Linear systems - Gauss elimination- Gauss Seidel methods-Applications of matrix methods to finding current in thecircuits.

UNIT-II: EIGEN VALUES-EIGEN VECTORS AND QUADRATIC FORMS:

Introduction-Eigen values-Eigen vectors-Properties(without proofs)-Cayley Hamilton theorem (without proof) - Inverse and power of a matrix by using Cayley Hamilton theorem, Diagonalisation of matrix-Quadratic forms- Reduction of Quadratic form to Canonical form-Rank-Index-Signature-Nature- Applications of Eigen value and Eigen vectors to Free Vibrations of two mass system.

UNIT-III: PARTIAL DIFFERENTIAL EQUATIONS:

Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions- Solutions of first order linear (Lagrange's) equation and nonlinear (standard type) equations- Equations reducible to standard forms.

UNIT-IV: VECTOR DIFFERENTIATION:

Differentiation of vectors-Scalar and Vector point functions- Gradient of a scalar field and directional derivatives- Divergence and Curl of a vector field and its physical interpretation- Solenoidal and Irrotational of a vector- Vector identities.

UNIT-V: VECTOR INTEGRATION:

Line integral- Circulation, Work done, Surface and Volume integrals-Vector integral theorems: Green's, Stoke's and Gauss's Divergence theorems(without proofs) and related problems.

TEXT BOOKS:

1. Higher Engineering Mathematics – 43rd Edition by Dr. B. S. Grewal, Khanna Publishers, NewDelhi.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreszig, 8thEd, Wiley Student Ed.
2. Advanced Engineering Mathematics, Greenburg, 2nd Ed, Pearson education.
3. Engineering Mathematics, N.P.Bali, Laxmi Publications (P)Ltd.
4. Engineering Mathematics, B. V. Ramana, TataMcGrawHill Publishing Co.Ltd.
5. Engineering Mathematics, P.Sivaramakrishna Das, C.Vijayakumari ,2017 Pearson India Education Services Pvt.Ltd

Course Code		L	T	P	Credits
1000171208	**ELECTRICAL CIRCUIT ANALYSIS-I**	3	1	0	3

Learning Objectives:

- To study the concepts of passive elements, types of sources and various network reduction techniques.
- To understand the applications of network topology to electrical circuits.
- To study the concept of magnetic coupled circuit.
- To understand the behavior of RLC networks for sinusoidal excitations.
- To study the performance of R-L, R-C and R-L-C circuits with variation of one of the parameters and to understand the concept of resonance.
- To understand the applications of network theorems for analysis of electrical networks.

Learning Outcomes:

Students are able to solve

- Various electrical networks in presence of active and passive elements.
- Electrical networks with network topology concepts.
- Any magnetic circuit with various dot conventions.
- Any R, L, C network with sinusoidal excitation.
- Any R, L, network with variation of any one of the parameters i.e R, L, C. and f.
- Electrical networks by using principles of network theorems

UNIT-I INTRODUCTION TO ELECTRICAL CIRCUITS

Circuit concept, R-L-C Parameters, Voltage and Current Sources, Independent and Dependent Sources, Source Transformation, Voltage– Current relationship for Passive Elements (for different input signals –Square, Ramp, Saw tooth and Triangular). Kirchhoff's Laws, Network Reduction Techniques – Series, Parallel, Series Parallel, Star –to-Delta or Delta-to-Star Transformations, Nodal Analysis, Mesh Analysis, Super node and Super mesh for DC Excitations.

UNIT-II MAGNETIC SYSTEMS & NETWORK TOPOLOGY

Basic definition of MMF, flux and reluctance; Analogy between electrical and magnetic circuits; Faraday's laws of electromagnetic induction Concept of self and mutual inductance; Dot convention-coefficient of coupling and composite magnetic circuit; Analysis of series and parallel magnetic circuits.

Definitions of Graph and Tree; Basic cutset and tieset matrices for planar networks; Loop and nodal methods of analysis of networks with dependent and independent voltage and current sources; Duality and Dual networks.

UNIT-III SINGLE PHASE AC SYSTEMS

Periodic waveforms (determination of rms, average value and form factor), Concept of phase angle and phase difference; Waveforms and phasor diagrams for lagging and leading networks; Complex and polar forms of representations, steady state analysis of R, L and C circuits; Power Factor and its significance Real, Reactive power and apparent Power.

UNIT-IV ANALYSIS OF AC NETWORKS

Extension of node and mesh analysis to AC networks, numerical Problems on Steady state analysis, series and parallel resonance, concept of band width and Quality factor; Locus diagrams for various combination of R, L and C.

UNIT-V NETWORK THEOREMS (DC & AC EXCITATIONS)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem, compensation theorem, Tellegen's theorem, and Substitution theorem.

Text Books:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, McGraw Hill Company, 6th edition

2. Network Analysis: Van Valkenburg; Prentice-Hall of India Private Ltd

Reference Books:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India)
2. Linear Circuit Analysis by De Carlo, Lin, Oxford publications
3. Electric Circuits– (Schaum's outlines) by Mahmood Nahvi& Joseph Edminister, Adapted by KumaRao, 5th Edition – McGrawHill.
4. Electric Circuits by David A. Bell, Oxfordpublications
5. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications
6. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi,DhanpatRai.

Course Code		L	T	P	Credits
1000171211	**APPLIED CHEMISTRY**	3	1	0	3

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

Objectives:

- Plastics are nowadays used in household appliances; also they are used as composites (FRP) in aerospace and auto motive industries.
- Fuels as a source of energy are a basic need of any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence they are introduced.
- To know the mechanism of Corrosion for its control and prevention.
- Water is a basic material in almost all the industries, more so where steam is generated and also where it is supplied for drinking purposes.
- With the increase in demand, a wide variety of materials are coming up; some of them have excellent engineering properties and a few of these materials are introduced.

Outcomes: The student

- Gains basic knowledge of polymer materials and their engineering applications.
- Understands fuels which are used commonly and their advantages and limitations.
- Extends the principles involved in corrosion to predict and prevent the corrosion in real life system
- The advantages and limitations of semiconducting materials and their use in design would be understood.
- Recalls the principles, working and design of energy storage devises and Acquires knowledge of advanced materials and their applications.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Identify various polymers like Polythene, PVC, Teflon, Bakelite and their Engineering applications.	Understanding	PO1,PO7, PO8
CO2	Desribe various renwable and non-renwable energy resources.	Applying	PO1, PO2, PO4, PO7, PO8
CO3	Aquire the knoweldge of principles and reaction mechanism Of corrosion.	Applying	PO1, PO7, PO8
CO4	Illustrate green Synthesis ,semiconductors , advanced materials and their applications in industry .	Analyzing	PO1, PO2, PO12

UNIT I: POLYMER TECHNOLOGY

Polymerization: Introduction - Types of polymerization (Addition, Condensation & Co-polymerizstion) – Physical and mechanical properties – advantages and limitations – **Plastics**: Thermoplastics and Thermosetting plastics –

Compounding, Moulding techniques (Compression, Injection & Blow film moulding) - Preparation, properties and applications of polyethene, PVC, Bakelite and Teflon.

Elastomers – Natural rubber- compounding and vulcanization – Synthetic rubbers - Buna S, Buna N and Thiokol – Applications. Composite materials & Fiber reinforced plastics (CFRP & GFRP) – Biodegradable polymers – Conducting polymers.

UNIT II: FUEL TECHNOLOGY

Introduction – Classification – Calorific value - Bomb calorimeter – Numerical problems – Coal — Proximate and ultimate analysis and its Significance – Liquid fuels – Petroleum - Refining – Cracking – knocking - Octane and Cetane numbers

- Natural gas - LPG and CNG – Combustion – Flue gas analysis – Orsat apparatus – Numerical problems on combustion. Energy scenario in India – working of thermal power plant – Advantages and disadvantages – Non renewable energy – Solar energy – Harnessing of solar energy – solar heaters – photo voltaic cells – Bio energy – Biodiesel.

UNIT III: ELECTROCHEMICAL CELLS & CORROSION

Galvanic cells - Reversible and irreversible cells, Electrode potential – Standard electrodes (Hydrogen and Calomel electrodes). Electro chemical series and its applications,

Batteries-: Dry Cell, lead acid battery and Ni-Cd battery - H_2-O_2 fuel cell & H_3PO_4 fuel cells.

Corrosion: Introduction – Theories of Corrosion (dry and wet) – Types of corrosion – galvanic, pitting, stress, differential aeration and waterline corrosion

– Factors influencing corrosion – controlling methods – Design and material selection – Cathodic protection - inhibitors - Protective coatings – Metallic coatings (cathodic and anodic) - Methods of application on metals (Galvanizing, Tinning & Electroplating).

UNIT IV: SOLID STATE CHEMISTRY

Typesofsolids - close packing of atoms and ions - BCC , FCC, structures of rock salt - cesium chloride- spinel - normal and inverse spinels, Non-elemental **semiconducting Materials**: Stoichiometric, controlled valency & Chalcogen photo/semiconductors, Preparation of Semiconductors - Semiconductor Devices:- p-n junction diode as rectifier – junctiontransistor.

Insulators (electrical and thermal applications)

Magnetic materials: Ferro and ferri magnetism - Hall- Effect and its applications.

UNIT V: CHEMISTRY OF ADVANCED ENGINEERING MATERIALS

Nano materials: Introduction – Preparation, Properties and engineering applications of Carbon nano tubes andfullerenes.

Liquid crystals: Introduction – Types – Applications.

Superconductors: Type-I & Type-2, properties & applications.

Green Chemistry: Principles, any three methods of synthesis – engineering applications.

Sensors & Biosensors: Classification, working principle & applications.

Explosives & Propellants: Introduction, classification & applications.

Prescribed books:

1. Engineering Chemistry (16^{th} edn.) by Jain and Jain; Dhanpat Rai Pub.Co.
2. A text book of engineering Chemistry by S. S. Dara; S. Chand & CoLtd., Latest Edition

Reference Books:

1. Chemistry for Engineers by Teh Fu Yen, Imperial college press,London.
2. Engineering Chemistry of Wiley India Pvt. Ltd., Vairam and others,2014 edition(second).
3. Engineering Chemistry by Shikha Agarwal; Cambridge UniversityPress, 2015 edition.
4. Applied Chemistry by H.D. Gesser, SpringerPublishers
5. Text book of Nano-science and nanotechnology by B.S. Murthy,P. Shankar and others, University Press,IIM.

Course Code	ENGINEERING MECHANICS	L	T	P	Credits
1000171216		3	1	0	3

Objectives: The students completing this course are expected to understand the concepts of forces and its resolution in different planes, resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analyze frames and trusses, different types of motion, friction and application of work – energy method.

- The students are to be exposed to the concepts of force and friction, direction and its application.
- The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.
- The students are to be exposed to concepts of centre of gravity
- The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.
- The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.
- The students are to be exposed to concepts of work, energy and particle motion

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO number mapped
CO1	Analyze the force systems for equilibrium conditions and able to draw free body diagram.	Understanding	PO1,PO2,PO3
CO2	Evaluate the frictional forces between contact surfaces.	Applying	PO1,PO2,PO3
CO3	Able to differentiate between centroid and centre of gravity and determine Centroid, centre of gravity and second moment of area for composite sections.	Applying	PO1,PO2,PO3
CO4	Analyse the motion and calculate trajectory characteristics.	Analyzing	PO1,PO2,PO3

UNIT-I:

Introduction to Engg. Mechanics, Basic Concepts. **Systems of Forces :**Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.

Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, Spatial Systems for concurrent forces, Lamis Theorm, Graphical method for the equilibrium of coplanar forces, Converse of the law of Triangle of forces, converse of the law of polygon of forces condition of equilibrium.

UNIT –II Friction:

Introduction **-** limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, cone of friction

UNIT – III Centroid :

Centroids of simple figures (from basic principles) – Centroids of Composite Figures, **Centre of Gravity :**Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, Pappus theorem.

UNIT IV

Area moments of Inertia : Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia :**Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – V

Kinematics : Rectilinear and Curvelinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion.

Kinetics : Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

Work – Energy Method : Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

TEXTBOOKS:

1. Engineering Mechanics - S. Timoshenko & D. H. Young., 4th Edn , Mc Graw Hill,publications.
2. Engineering Mechanics: Statics and Dynamics 3rd edition, Andrew Pytel and Jaan Kiusalaas, Cengage Learningpublishers.

REFERENCES:

1. Engineering Mechanics statics and dynamics – R. C. Hibbeler, 11th Edn – Pearson Publ.
2. Engineering Mechanics, statics, J. L. Meriam, 6th Edn – Wiley India PvtLtd.
3. Engineering Mechanics, dynamics, J. L. Meriam, 6th Edn – Wiley India Pvt Ltd.
4. Engineering Mechanics, statics and dynamics – I. H. Shames, – Pearson Publications
5. Mechanics For Engineers, statics - F. P. Beer & E. R. Johnston – 5th Edn Mc Graw Hill,Publ.
6. Mechanics For Engineers, dynamics - F. P. Beer & E. R. Johnston – 5th Edn Mc Graw,HillPubl.
7. Theory & Problems of engineering mechanics, statics & dynamics – E. W. Nelson, C.LBest & W.G. McLean, 5th Edn – Schaum's outline series - Mc Graw Hill Publ.
8. Engineering Mechanics, Ferdinand. L. Singer, Harper –Collins.
9. Engineering Mechanics statics and dynamics, A Nelson, Mc Graw Hill publications Engineering Mechanics, Tayal. UmeshPublications

Course Code		L	T	P	Credits
1000171221	**ENGLISH COMMUNICATION SKILLS LAB-2**	0	0	3	2

Objectives:

This Lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:

To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio- cultural and professional contexts. Further, they would be required to communicate their ideas relevantly and coherently in writing.

Course outcomes: The proposed course to enable students to use 'good' English and perform the following: Gather ideas and information, to organize ideas relevantly and coherently.

Engage in debates. Participate in group discussions. Face interviews. Write project/research reports/technical reports. Make oral presentations.

Writing formal letters and to take part in social and professional communication.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Demonstrate the usage of phonemes while referring to the dictionary	Understanding	PO5,PO9, PO10, PO12
CO2	Articulate with others by using proper functions.	Applying	PO5,PO9, PO10, PO12
CO3	Enact the roles with proper body language.	Applying	PO5,PO9, PO10, PO12
CO4	Communicate fluently with proper pronunciation	Analyzing	PO5,PO9, PO10, PO12

Unit-1: Pronouncing Words

Unit-2: Interaction 3

Unit-3: Stress & Intonation

Unit-4: Interaction 4

PRESCRIBED LAB MANUAL:

Speak Well - Orient Black Swan Publishers

SUGGESTED BOOKS/ MANUALS AND SOFTWARES:

1. Interact - Orient BlackSwan
2. The Rosetta Stone EnglishLibrary
3. Language inUse
4. English inMind

Course Code		L	T	P	Credits
1000171224	**ENGINEERING WORKSHOP**	0	0	3	2

Course Objective:

To impart hands-on practice on basic engineering trades and skills. Note:

At least two exercises to be done from each trade.

Trade:

Carpentry
1. T-LapJoint
2. Cross LapJoint
3. DovetailJoint
4. Mortise and TenonJoint

Fitting
1. VeeFit
2. SquareFit
3. Half Round Fit
4. Dovetail Fit

BlackSmithy
1. Round rod toSquare
2. S-Hook
3. Round Rod to FlatRing
4. Round Rod to Square headedbolt

HouseWiring
1. Parallel / Series Connection of threebulbs
2. Stair Casewiring
3. Florescent LampFitting
4. Measurement of EarthResistance

TinSmithy
1. TaperTray
2. Square Box withoutlid
3. OpenScoop
4. Funnel

Course Code	ENGINEERING CHEMISTRY LABORATORY	L	T	P	Credits
1000171227		0	0	3	2

List of Experiments

1. Determination of hardness of water using standard EDTA solution
2. Determination of Total alkalinity of a water sample.
3. Determination of Ferrous iron using standard $K_2Cr_2O_7$solution.
4. Determination of Copper using standard EDTA solution.
5. Determination of Iron in cement by Colorimetric method
6. Determination of Zinc by ferro cyanide method.
7. Determination of strong acid by Conductometrictitration
8. Determination of Acetic acid by Conductometrictitration
9. Determination of iron by Potentiometric method using$K_2Cr_2O_7$
10. Preparation of Phenol formaldehyderesin
11. Determination of Vitamin –C
12. Determination of flash and fire point of a lubricant oil.
13. Determination of viscosity of a lubricant by Red-wood viscometer.
14. Advanced design experiment - Preparation of Bio diesel.
15. Additional design experiment - Construction of Galvaniccell

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Learn and apply basic techniques used in Chemistry laboratory for small/medium scale water analysis.	Understanding	PO1,PO2, PO9
CO2	Estimate the metal ions present in a domestic/industry sample solutions.	Applying	PO1, PO2, PO7, PO12
CO3	Utilize the fundamental laboratory techniques for titrations and synthetic procedures.	Applying	PO1, PO2, PO9
CO4	Analyze data and gain experimental skills through instrumentation	Analyzing	PO1, PO2, PO5, PO9, PO12

***The student should carry out a minimum of 12 experiments.**

Outcomes:
The student is able to acquire principles of various analytical techniques and their applications.

Reference Books:

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.
2. Dr. Jyotsna Cherukuris (2012) Laboratory Manual of engineering chemistry-II, VGS TechnoSeries
3. Chemistry Practical Manual, Lorven Publications
4. K. Mukkanti (2009) Practical Engineering Chemistry, B.S. Publication

PROGRAM STRUCUTE

FOR

II B.TECH

I &II SEMESTERS

PROGRAM STRUCTURE

II B.Tech I Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	1002172101	Electrical Circuit Analysis – II	3	1	0	3
2	1002172102	Electrical Machines-I	3	1	0	3
3	1002172103	Basic Electronic Devices &Circuits	3	1	0	3
4	1002172104	Electro Magnetic Fields	3	1	0	3
5	1002172105	Thermal and Hydro Prime movers	3	1	0	3
6	1002172121	Electrical Circuits Laboratory	0	0	3	2
7	1002172122	Electrical Machines -I Laboratory	0	0	3	2
8	1002172123	Hydraulic Machinery lab	0	0	3	2
		Total Credits:				**21**
II B.Tech II Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	1002172201	Electrical Machines-II	3	1	0	3
2	1002172202	Control Systems	3	1	0	3
3	1002172203	Power Generation Engineering & Economics	3	1	0	3
4	1002172204	Analog Electronics	3	1	0	3
5	1002172205	Data Structures	3	1	0	3
6	1099172106	Managerial Economics & Financial Analysis	3	1	0	3
7	1002172221	Electrical Machines –II Laboratory	0	0	3	2
8	1002172222	Electronic Devices & Circuits Laboratory	0	0	3	2
9	1002172231	Industrial visit	0	0	0	2
		Total Credits:				**24**

DETAILED SYLLABUS

FOR

II B.TECH

I SEMESTER

Course Code		L	T	P	Credits
1002172101	**ELECTRICAL CIRCUIT ANALYSIS-II**	3	1	0	3

Course Overview:

This course aims at study of three phase systems, transient analysis, network synthesis and Fourier analysis for the future study and analysis of power systems.

Course Objectives:

1. To study the concepts of balanced and unbalanced three-phase circuits.
2. To study the transient behavior of electrical networks with DC, pulse and AC excitations.
3. To study the performance of a network based on input and output excitation/response.
4. To understand the realization of electrical network function into electrical equivalent passiv elements.
5. To understand the application of Fourier series and Fourier transforms for analysis c electrical circuits.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Solve three- phase circuits under balanced and unbalanced condition	Analyzing (4)	2, 4, 6, 12
CO2	Analyze the transient response of electrical networks for different types of excitations	Analyzing (4)	2, 4, 6, 12
CO3	Determine parameters for different types of network.	Analyzing (4)	2, 4, 6, 12
CO4	Realize electrical equivalent network for a given network transfer function	Analyzing (4)	2, 4, 6, 12
CO5	Extract different harmonics components from the response of a electrical network	Analyzing (4)	2, 4, 6, 12

Unit-I:

Balanced and Unbalanced Three phase Circuits:

Balanced Three Phase Circuits: Phase sequence-star and delta connection-relation between line and phase voltages and currents-analysis of balanced three phase circuits-measurement of active and reactive power.

Unbalanced Three Phase Circuits:

Analysis of three phase unbalanced circuits: Loop method-Star-Delta transformation technique, Two wattmeter methods for measurement of three phase power.

Outcome:

Students will be able to Solve three- phase circuits under balanced and unbalanced condition

Activity/Event: Activity on Three phase power Measurement.

Unit-II:

Transient Analysis in DC and AC circuits

Transient response of R-L, R-C, R-L-C circuits for DC and AC excitations, Solution using differential equations and Laplace transforms.

Outcome: Students will be able to analyze the transient response of electrical networks for different types of excitations.

Activity/Event: Activity on RL Circuit and RC Circuit

Unit-III:

Two Port Networks

Two port network parameters – Z, Y, ABCD and Hybrid parameters and their relations, Cascaded networks - Poles and zeros of network functions.

Outcome: Students will be able to determine parameters for different types of network.

Activity/Event: Activity on Two port Network

Unit-IV:

Network synthesis:

Positive real function - basic synthesis procedure - LC immittance functions - RC impedance functions and RL admittance function - RL impedance function and RC admittance function - Foster and Cauer methods.

Outcome: Students will be able to Realize electrical equivalent network for a given network transfer function

Activity/Event: Activity on electrical equivalent network

Unit-V:

Fourier analysis and Transforms:

Fourier theorem- Trigonometric form and exponential form of Fourier series, Conditions of symmetry- line spectra and phase angle spectra, Analysis of electrical circuits to non sinusoidal periodic waveforms.

Fourier integrals and Fourier transforms – properties of Fourier transforms physical significance of the Fourier Transform and its application to electrical circuits.

Outcome: Students will be able to Extract different harmonics components from the response of a electrical network.

Activity/Event: Activity on Harmonic Analysis.

Text Books:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley,McGraw Hill Company,6^{th} edition
2. Network synthesis: Van Valkenburg; Prentice-Hall of India Private Ltd

Reference Books:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India)
2. Introduction to circuit analysis and design by TildonGlisson. Jr, Springer Publications.
3. Circuits by A.Bruce Carlson , Cengage Learning Publications
4. Network Theory Analysis and Synthesis by SmarajitGhosh, PHI publications
5. Networks and Systems by D. Roy Choudhury, New Age International publishers
6. Electric Circuits by David A. Bell, Oxford publications
7. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi,DhanpatRai&Co.

Course Code	ELECTRICAL MACHINES-I	L	T	P	Credits
1002172102		3	1	0	3

Course Overview:

This is a basic course on rotating electrical machines. This course covers the topics related to principles, performance and applications of dc machines and transformers.

Course Objectives:

1. To understand the unifying principles of electromagnetic energy conversion and construction of DC machines.
2. To learn the characteristics, performance, methods of speed control and testing methods of DC motors.
3. To predetermine the performance of single phase transformers with equivalent circuit Models.
4. To understand the methods of testing of single-phase transformer.
5. To Analyze the three phase transformers and achieve three phase to two phase conversion.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the electromechanical Energy Conversion, Performance and testing of D.C. Machines	Understand (2)	1, 2, 3
CO2	Demonstrate the performance of 1-φ transformers	Demonstrate (4)	1, 2
CO3	Analyze various tests to determine the performance of 1-φ transformers	Analyze (4)	1, 2
CO4	Illustrate auto transformer and various types of 3-φ connections.	Apply (3)	1, 2

Unit-I:

Electromechanical Energy Conversion and introduction to DC machines:

Principles of electromechanical energy conversion – singly excited and multi excited system Construction and principle of operation of DC machine – Armature Windings-EMF equation for generator – Classification of DC machines based on excitation – OCC of DC shunt generator. Armature reaction and commutation– Torque and back-emf equations of dc motors.

Outcome: At the end of the unit, students will be able to

1. Discuss the basic principles of electromechanical energy conversion.

Activity/Event: Prepare a report on classification of DC machines based on excitation or prepare a proto type DC motor/Generator.

Unit-II:

Performance and testing of DC. Machines:

Characteristics of separately-excited and self excited motors (shunt, series and compound) - losses and efficiency- applications of dc motors. Necessity of starter – Starting by 3 point and 4 point starters – Speed control by armature rheostat and field control – Testing of DC machines - brake test, Swinburne's method –- retardation test.

Outcome: At the end of the unit, students will be able to

1. Classify the various characteristics and speed control methods of DC machines

Activity/Event: To make Collage on a chart by students on DC machine characteristics. Using any software (C or MATLAB) draw the DC machine characteristics.

Unit-III:

Single-phase Transformers

Types and constructional details - principle of operation - emf equation - operation on no load and operation on load – lagging, leading and unity power factor loads of transformers – equivalent circuit(Exact and approximate) – regulation – losses and efficiency. All day efficiency

Outcome: At the end of the unit, students will be able to

1. Analyze the equivalent circuit of single phase transformer.

Activity/Event:

1. To see a practical transformer and prepare a report on the observation made.

Unit-IV:

Single-phase Transformers Testing:

Tests on single phase transformers – open circuit and short circuit tests – Sumpner's test – separation of losses – effect of variation of frequency and supply voltage on losses-parallel operation with equal voltage ratios and problems.

Outcome: At the end of the course, students will be able to

1. Identify the conditions of parallel operation and distinguish various types of losses that occur in single phase transformer

Activity/Event: Implementation of open circuit and short circuit tests using Virtual labs / MATLAB.

Unit-V:

Auto transformers and 3-Phase Transformers:

Auto transformer – comparison with two winding transformers-Evaluation of Auto transformer from two winding transformer. Poly phase connections - Y/Y, Y/Δ, Δ/Y, Δ/Δ and open Δ -- Third harmonics in phase voltages- off load and on load tap changers – Scott connection.

Outcome: At the end of the unit, students will be able to

1. Classify the various poly phase connections and analyze various tap changers.

Activity/Event:

1. Prepare a report on different connections of the transformer and their applications.

Text Books:

1. Electrical Machines – P.S. Bhimbra, Khanna Publishers
2. Electrical Machines by R.K.Rajput, Lakshmi publications,5th edition

Reference Books:

1. Electrical Machines by D. P.Kothari, I .J .Nagarth, McGraw Hill Publications, 4th edition
2. Electric Machinery by A.E.Fitzgerald, Charles Kingsley, Stephen D.Umans, TMH
3. Electrical Machinery by Abijith Chakrabarthi and Sudhipta Debnath, McGraw Hill education 2015
4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2010
5. Electric Machines by Mulukutla S. Sarma & Mukeshk. Pathak, CENGAGE Learning.
6. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons

Course Code		L	T	P	Credits
1002172103	**BASIC ELECTRONIC DEVICES & CIRCUITS**	3	1	0	3

Course Overview:

This course introduces the operation of various semi-conductor devices. Realization of rectifiers, amplifiers and oscillators using semi-conductor devices and their analysis is also introduced in this course.

Course Objectives:

1. To study the construction details, operation and characteristics of junction diode and special diodes
2. To understand the operation and analysis of rectifiers with and without filters and study the operation of series and shunt regulators using zener diodes.
3. To learn biasing stabilization and compensation methods and to analyze transistor amplifiers using h-parameters.
4. To understand the concepts of positive and negative feedbacks and their role in amplifiers and oscillators.

Course outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Distinguish the characteristics of different diodes and choose appropriate diode for an application based on the operation	Analyze (4)	1, 2, 3, 4, 5, 6, 7, 11
CO2	Explain the operation and design aspects of rectifiers, filters and regulators	Create (6)	1, 2, 3, 4, 5, 6, 7, 11
CO3	Design different biasing and stabilization circuits and explain compensation techniques for a transistor	Create (6)	1, 2, 3, 4, 5, 6, 7, 11
CO4	Explain the merits and demerits of positive and negative feedback and the role of feedback in oscillators and amplifiers	Create (6)	1, 2, 3, 4, 5, 6, 7, 11

Unit-I:

Junction Diode Characteristics:

Introduction to semiconductor materials, operation and characteristics of p-n junction diode, Current components in p-n diode, diode equation, Temperature dependence on V–I characteristic, diffusion capacitance and diode resistance (static and dynamic), energy band diagram of p-n diode.
Special Diodes: Avalanche and Zener break down, Zener characteristics, tunnel diode, characteristics with the help of energy band diagrams, Varactor diode, LED, PIN diode, Photo diode.
Outcome: Students will be able to explain the operation and characteristics of PN junction diode and special diodes.

Activity/Event: Plot the characteristics of diode

Unit-II:

Rectifiers, Filters and Regulators:
Half wave rectifier, ripple factor, full wave rectifier (with and without transformer), harmonic components in a rectifier circuit

Filters: inductor filter, capacitor filter
Simple circuit of a regulator using Zener diode. Types of regulators-series and shunt voltage regulators, over load voltage protection

Outcome: Students will be able to explain operation and design aspects of rectifiers and regulators.

Activity/Event: Construct a rectifier circuit.

Unit-III:

Transistors
Junction transistor, transistor current components, transistor as an amplifier and switch. Characteristics of transistor (CE, CB and CC configurations)
FET: JFET Characteristics (Qualitative explanation), MOSFET Characteristics–static and Transfer (enhancement and depletion mode)

Outcome: Students will be able to explain the characteristics of various transistor configurations

Activity/Event: Plot the characteristics of transistor

Unit-IV:

Biasing and Small signal Amplifiers:

Need for Transistor biasing and biasing methods (to fixed bias, collector to base bias, self bias), thermal runaway, thermal stability. Compensation against variation in base emitter voltage and collector current.
Hybrid model of transistor. Analysis of transistor amplifier using h-parameters.

FET: Low frequency model of FET, FET as an amplifier.

Outcome: Students will be able to explain the design procedure of different biasing, stabilization and compensation techniques used in transistor circuits

Activity/Event: Construct a fixed bias circuit

Unit-V:

Amplifiers and oscillators:

Feedback Amplifiers -classification, feedback concept, transfer gain and general characteristics of negative feedback amplifiers, effect of feedback on input and output resistances. Methods of analysis of feedback amplifiers.
Power Amplifiers – Classification, push-pull amplifiers
Oscillators – Condition for oscillation, RC-phase shift oscillator. Wein bridge oscillator, Crystal oscillator.

Outcome: Students will be able to explain the merits and demerits of positive and negative feedback and analyze the role of feedback in oscillators and amplifiers.

Activity/Event: Construct a RC-phase shift oscillator

Text Books:

1. Electronic Devices and Circuits – Salivahanan, Kumar, Vallavaraj, TATA McGraw Hill,Second Edition

Reference Books:

1. Electronic Devices and Circuits – J. Millman, C.C. Halkias, Tata Mc-Graw Hill
2. Electronic Devices and Circuits – R.L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall, 9thEdition, 2006
3. Electronic Devices and Circuits by David A. Bell, Oxford University Press

Course Code 1002172104	ELECTRO MAGNETIC FIELDS	L	T	P	Credits
		31	0	3	

Course Overview:

Electromagnetic field theory is the most fundamental course in the curriculum of electrical engineering education. Electromagnetic field theory defines capacitors, inductors and resistors in terms of their primary electric and magnetic quantities like electric charge, electric potential, electric current, electric and magnetic flux. Electromagnetics explains universal concepts in three-dimension real world, i.e., electro-magnetic wave propagation in free-space

Course Objectives:

1. To study the production of electric field due to different charge configurations and to understand the application of Gauss Law.
2. To study the production of magnetic field due to different current configurations, and to understand the application of Ampere's law.
3. To understand the behavior of materials in Electric Field and to study the magnetic force.
4. To do inductance and capacitance calculations.
5. To study Maxwell's equations and EM wave propagation.

Course outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Calculate electric field from various charge distributions and find magnetic field from various current distributions	Analyze (4)	1, 2, 3
CO2	Determine polarization in dielectrics, electric current density, and resistance of conductors and also Calculate force in electric and magnetic fields and torque in magnetic fields	Determine (4)	1, 2, 3
CO3	Compute inductance, capacitance of different physical configurations	Apply (3)	1, 2, 3
CO4	Apply Faraday's Law to calculate induced Emf.	Apply (3)	1,2,3

Unit-I:

Electrostatic Fields:

Review of Vector calculus, coordinate systems, Coulomb's Law – Electric Field Intensity (EFI)- EFI due to a finite and infinite line charges- Gauss's law & applications-Work done in moving a

point charge in an Electrostatic field- Electric Potential & Potential gradient - Laplace's and Poison's equations. Electric dipole – Dipole moment – potential and EFI due to an electric dipole- Torque on an Electric dipole.

Outcome:

- Calculate electric field, force, potential, energy from various charges and charge distributions

Activity/Event :

- Finding the Electric field in PN diode to withstand given threshold voltage.
- Prepare a report on Applications of Static Electric Fields.

Unit-II:

Static magnetic fields:

Biot-Savart's law &*Oersted's* experiment-Magnetic field intensity (MFI) magnetic flux density-MFI due to a straight current carrying filament- Ampere's circuital law -Point form of Ampere's circuital law- Applications of Amperes law viz. MFI due to an infinite sheet of current, a long filament carrying conductor, solenoid current a circular loop, rectangular loop- Magnetic Levitation principles

Outcome:

- Calculate magnetic field and energy due to various current distributions.

Activity/Event :

- Determine the maximum flux density to avoid saturation of a transformer with different cores.
- Prepare a report on application of magnetic levitation to Bullet trains.

Unit-III:

Materials in Electric Field

Dielectrics- polarization- Behavior of Conductors and Insulators-Boundary conditions-Conduction and Convection current densities-Ohm's law in point form, Equation of continuity.

Magnetic force

Lorentz force equation – Force on a current element in a magnetic field- Force on a straight and a long current carrying conductor in a magnetic field- Force between two straight long and parallel current carrying conductors - Torque on a current loop placed in a magnetic field- Application of Electromagnetic meta Materials.

Outcome:

- Calculate polarization in dielectrics, electric current density, electric current and resistance of conductors.
- Calculate forces in electric and magnetic fields and torque in magnetic fields.

Activity/Event :

- Determining the suitable conductor size for a given transmission line to withstand maximum current density.
- Finding magnetic Force of given electromagnetic relay during fault conditions.

Unit-IV:

Capacitance Calculations:

Energy stored and energy density in a static electric field- Capacitance & capacitance of parallel plates with composite dielectrics -capacitance of spherical and coaxial cables.

Inductance Calculations:

Energy stored and density in a magnetic field-Self and Mutual inductance -determination of self-inductance of a solenoid and to roid.

Outcome:

- Calculate inductances, capacitance of different structures.

Activity/Event:

- Finding of Inductance and capacitance for a given 33kv transmission line including the effect of Earth.

Unit-V:

Time varying fields:

Faraday's laws of electromagnetic induction Its integral and point forms -Maxwell's fourth equation, Curl (E)=-∂B/∂t- Statically and Dynamically induced EMFs, Simple problems - Modification of Maxwell's equations for time varying fields- Displacement current- Poynting Theorem and Poynting vector. EM wave equation and uniform plane waves in free space.

Outcome:

- Apply Faraday's Law to calculate induced Emf.

Activity/Event:

- Observe the production of induced emf with different types of cores (i.e silicon steel, CRGO) and make a report.

- Make a Report on Effects of Electromagnetic Interference on communication lines, on power lines and on human.

Text Books:

1. William H Hayt and Jr John A Buck, "Engineering Electro magnetics", 6th Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008
2. Sadiku MN, "Elements of Electro magnetics", 3rd Edition, Oxford University Press Inc, NewDelhi,2001

Reference Books:

1. "Introduction to Electro Dynamics", by D J Griffiths, Prentice-Hall of India Pvt.Ltd, 2nd Edition.
2. "Electromagnetic Field Theory" by Yaduvir Singh, Pearson.
3. "Fundamentals of Engineering Electromagnetics" by Sunil Bhooshan, Oxford higher Education
4. " Electromagnetic Field Theory" by Gangadhar, Khanna publications.
5. "Elements of Electromagnetic Fields", by SP Seth, Dhanpat Rai &co .
6. " Problems and solutions of Engineering Electromagnetics", CBS Publications.

Course Code	THERMAL AND HYDRO PRIME MOVERS	L	T	P	Credits
1002172105		3	1	0	3

Course Overview:

This course deals with various vapor power cycles along with different types of hydraulic turbines/pumps and performance measurements. Course also includes the understanding of hydroelectric power plants and their load calculations.

Course Objectives:

The Student able to

1. Learn how to calculate the performance of steam turbines using velocity diagrams. Correlate between the air standard cycles and the actual cycles that govern the steam turbines
2. Impart the knowledge of gas turbine fundamentals, the governing cycles and the methods to improve the efficiency of gas turbines.
3. Understand the fundamental of fluid dynamic equations and its applications fluid jets. To impart the knowledge of various types of pumps, their constructional features, working and performance
4. Learn about the constructional features, operational details of various types of hydraulic turbines and to calculate the performance of hydraulic turbines
5. Understand the types of hydro electric power plants, estimation and calculation of different loads by considering various factors.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the basic cycles and calculations involved in the operation of steam and gas turbines	Understand (2)	1, 2,
CO2	Discuss the operation and performance of reciprocating and centrifugal pumps	Analyze (4)	1, 2, 4
CO3	Explain basic concepts of turbo machines and describe the working of Pelton, Francis and Kaplan along their performance parameters	Analyze (4)	1, 2, 4
CO4	Summarize the layout and components in a hydroelectric power plant and extend their knowledge to power plant economics	Analyze (4)	1,2,4,5

Unit-I:

Vapor Power Cycles: Carnot Cycle-Rankine Cycle-Thermodynamic Variables Effecting Efficiency and output of Rankine Cycle.

Steam Turbines: Schematic layout of steam power plant. Classification of Steam Turbines-Impulse Turbine and Reaction Turbine. Velocity Diagrams for simple Impulse and Reaction Turbines- Work done & efficiency.

Outcome:

- Solve problems based on Rankine cycle and compare its efficiency with Carnot cycle.
- Distinguish between impulse and reaction turbines
- Plot velocity diagrams and calculate efficiency for impulse and reaction turbines

Activity/Event:

- Make a prototype model of simple impulse and reaction turbines and differentiate.

Unit-II:

Gas Turbines: Simple gas turbine plant-ideal cycle, closed cycle, open cycle. Efficiency, Work ratio and optimum pressure ratio for simple gas turbine cycle. Actual cycle, analysis of simple cycles & cycles with inter cooling, reheating and regeneration.

Outcome:

- Distinguish between open cycle and closed cycle gas turbine plant
- Derive expressions for work done and efficiencies of open/closed cycle plants.
- Compare and classify the methods of increasing efficiency of gas turbine plant

Activity/Event:

- Draw the schematic diagrams of simple gas turbine power plant, regeneration plant, reheat plant and plant with inter cooling along with T-s plots on a A3 sheet to understand the difference between all of them.

Unit-III:

Impact of Jets And Pumps: Impulse momentum equation, Impact of Jet on stationary and moving vanes (flat, inclined and curved), related problems.
Pumps: Types of pumps: Reciprocating and Centrifugal pumps: Main components, Working principle, Multi stage pumps, Performance.

Outcome:

- Derive expressions for force acting on flat, inclined and curved vanes.
- Distinguish between working principles of reciprocating and centrifugal pumps.
- Determine performance of reciprocating and centrifugal pumps.

Activity/Event:

- Make a miniature model of any type of pump and calculate the work done and efficiency.

Unit-IV:

Hydraulic Turbines:

Classification of turbines; Working principle, Efficiency calculation and Design principles for Pelton Wheel, Francis and Kaplan turbines; Governing of turbines, Performance.

Outcome:

- Classify types of turbines and their working principles.
- Explain design considerations of Pelton, Francis and Kaplan turbines
- Calculate the performance of Pelton, Francis and Kaplan turbines

Activity/Event:

- Make a prototype model of various turbine components using domestic materials.

Unit-V:

Hydro Power:

Components of Hydroelectric power plant: pumped storage systems, Estimation of water power potential; Estimation of load on turbines: load curve, load factor, capacity factor, utilization factor, diversity factor, load–duration curve, firm power, secondary power, prediction of load.

Outcome:

- Explain the functioning of all components of Hydroelectric power plant
- Learn all the factors related to power plant load calculations
- Solve problems related to load calculations.

Activity/Event:

- Make a prototype model of pumped storage hydroelectric power plant.

Text Books:

1. Thermal Engineering by R.K.Rajput, Lakshmi publications
2. Thermal engineering by M.L.Mathur and F.S.Mehta, Jain Brothers.
3. “Hydraulics & Fluid Mechanics”, P.N. Modi and S.M. Seth, Textbooks House, Delhi
4. “Fluid Mechanics& Hydraulic Machinery” R.K.Bansal, Lakshmi publications.
5. Power Plant Engineering by G.R.Nagpal.

Course code	ELECTRICAL CIRCUITS LABORATORY	L	T	P	Credits
1002172121		0	0	3	2

Course Objectives:

To verify and demonstrate various theorems, locus diagrams, resonance and two port networks. To determine self and mutual inductance of a magnetic circuit, parameters of a given coil and measurement of 3- phase power.

1. Verification of Thevenin's and Norton's Theorems
2. Verification of Superposition theorem and Maximum Power Transfer Theorem
3. Verification of Compensation Theorem
4. Verification of Reciprocity, Millmann's Theorems
5. Locus Diagrams of RL and RC Series Circuits
6. Series Resonance
7. Determination of Self, Mutual Inductances and Coefficient of coupling
8. Determination of Z and Y Parameters
9. Determination of Transmission and hybrid parameters
10. Determination of Parameters of a choke coil.
11. Determination of cold and hot resistance of an electric lamp.
12. Measurement of 3-phase Power by two Wattmeter Method for Balanced and unbalanced loads.

Learning outcomes:

Able to apply various theorems, determination of self and mutual inductances, two port parameters of a given electric circuits. Able to draw locus diagrams. Phasor diagram for lagging and leading networks.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	To determine and predetermine the performance of DC machines and 1-phase Transformers	Analyze (4)	1, 2, 3, 9
CO2	To control the speed of DC motor	Analyze (4)	1, 2, 3, 9
CO3	To achieve three phase to two phase transformation	Apply (3)	1, 2, 9

Course Code		L	T	P	Credits
1002172122	ELECTRICAL MACHINES -I LABORATORY	0	0	3	2

Course Objectives:

1. To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
2. To control the speed of the DC motors.
3. Determine and predetermine the performance of DC machines.
4. To predetermine the efficiency and regulation of transformers and assess their performance.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	To determine and predetermine the performance of DC machines and 1-phase Transformers	Analyze (4)	1, 2, 3, 9
CO2	To control the speed of DC motor	Analyze (4)	1, 2, 3, 9
CO3	To achieve three phase to two phase transformation	Apply (3)	1, 2, 9

List of Experiments:

1. Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.
2. Brake test on DC shunt motor. Determination of performance curves.
3. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
4. Speed control of DC shunt motor by Field and armature Control.
5. Retardation test on DC shunt motor. Determination of losses at rated speed.
6. OC & SC test on single phase transformer.
7. Sumpner's test on single phase transformer.
8. Scott connection of transformers
9. Parallel operation of Single phase Transformers
10. Separation of core losses of a single phase transformer

Course code	HYDRAULIC MACHINERY LAB	L	T	P	Credits
1002172123		0	0	3	2

Course Objectives:

To impart practical exposure on the performance evaluation methods of various hydraulic turbines and pumps.

1. Determination of force exerted by a jet of water on a flat vane.
2. Determination of force exerted by a jet of water on a curved Vanes.
3. Performance Test on Pelton Wheel at constant head.
4. Performance Test on Pelton Wheel at constant speed.
5. Performance Test on Francis Turbine at constant head.
6. Performance Test on Francis Turbine at constant speed
7. Performance Test on Kaplan Turbine at constant speed.
8. Performance Test on Kaplan Turbine at constant head.
9. Performance Test on Single Stage Centrifugal Pump.
10. Performance Test on Multi Stage Centrifugal Pump.
11. Performance Test on Reciprocating Pump.
12. Determination of slip of a Reciprocating Pump.

Course code	ELECTRICAL MACHINES-II	L	T	P	Credits
1002172201		3	1	0	3

Course Overview: This is a course on rotating electrical machines. This course covers the topics related to principles, performance and applications of three-phase induction motor, synchronous generators and synchronous motors.

Course Objectives:

1. To discuss the principle of operation and performance of three-phase induction motor.
2. To explain the torque producing mechanism of a single phase induction motor.
3. To describe the principle of emf generation, the effect of armature reaction and predetermination of voltage regulation in synchronous generators.
4. To elaborate the operation, performance and starting methods of synchronous motors.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe the performance of 3-phase induction motor and induction generator and quantifying terms of torque and slip	Describe (1)	1, 2, 3
CO2	Analyze the torque producing mechanism of a single phase induction motor	Analyze (4)	1, 2
CO3	Study parallel operation and control of real and reactive powers for synchronous generators	Understand (2)	1, 2
CO4	List out starting methods of synchronous motors	Understand (2)	1, 3, 4

Unit-I:

3-phase Induction Motors:

Construction details of cage and wound rotor machines - production of rotating magnetic field - principle of operation - rotor emf and rotor frequency - rotor current and pf at standstill and during running conditions - rotor power input, rotor copper loss and mechanical power developed and their interrelationship – equivalent circuit – phasor diagram

Outcome:

At the end of the unit, students will be able to

1. Recall the concepts of performance of three-phase induction motor

Activity/Event:

1. Show the cut section of a small three-phase induction motor to the students, to enable them to identify the parts**.**

Unit-II:

Characteristics and testing methods of Induction Motors:

Torque equation - expressions for maximum torque and starting torque - torque slip characteristic - double cage and deep bar rotors - crawling and cogging – speed control of induction motor with V/f method – no load and blocked rotor tests - circle diagram for predetermination of performance– methods of starting – starting current and torque calculations – induction generator operation (Qualitative treatment only)

Outcome:

At the end of the unit, students will be able to

- Classify the various testing methods of3-phase induction motors and determine the efficiency.

Activity/Event:

- Show animated video on three phase induction motor.

Unit-III:

Starting methods of 3 phase and single phase Induction Motors and special machines:

Methods of starting – starting current and torque calculations – induction generator operation (Qualitative treatment only)
Single phase induction motors – Constructional features and equivalent circuit- Problem of starting–Double revolving field theory–Starting methods,
Basic Principles of BLDC, SRM motors and universal motor.

Outcome:

At the end of the unit, students will be able to

- Analyze the starting methods of 3 phase Induction Motors and Single Phase IM

Activity/Event:

1. Seminar on BLDC motors by students

Unit-IV:

Construction, Operation and Voltage Regulation of Synchronous generator:

Constructional features of non–salient and salient pole type – Armature windings– Distribution– Pitch and winding factors –E.M.F equation-Armature reaction-Voltage regulation by synchronous impedance method– MMF method and Potier triangle method– Phasor diagrams– Two reaction analysis of salient pole machines and phasordiagram.

Outcome: At the end of the unit, students will be able to

1. Classify the regulation methods of Synchronous generators.

Activity/Event:

1. Conduct an experiment in the lab to find the regulation of Synchronous generators.

Unit-V:

Parallel operation of Synchronous generator, Synchronous motor – operation, starting and performance:

Parallel operation with infinite bus and other alternators – Synchronizing power – Load sharing- Control of real and reactive power- Numerical problems
Synchronous Motor principle and theory of operation– Phasor diagram – Starting torque– Variation of current and power factor with excitation –Synchronous condenser – Mathematical analysis for power developed– Hunting and its suppression – Methods of starting – Applications

Outcome:

At the end of the course, students will be able to

1. Analyze the performance of Synchronous motor.

Activity/Event:

1. Group discussion on methods of starting of Synchronous motor.

Text Books:

1. Electrical Machines – P.S. Bhimbra, Khanna Publishers
2. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition

Reference Books:

1. Electrical Machines by D. P.Kothari, I .J .Nagarth, McGraw Hill Publications, 4th edition
2. Electric Machinery by A.E.Fitzgerald, Charleskingsley, Stephen D.Umans, TMH
3. Electrical Machinery by Abijith Chakrabarthi and Sudhipta Debnath, McGraw Hill education 2015
4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2010
5. Electric Machines by Mulukutla S.Sarma &Mukeshk. Pathak, CENGAGE Learning.
6. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons

Course Code		L	T	P	Credits
1002172202	**CONTROL SYSTEMS**	3	1	0	3

Course Overview:

This course introduces the elements of linear control systems and their analysis. Classical methods of design Controllers using frequency response. The state space approach for design and modelling. Analysis of simple PD,PID controllers

Course Objectives:

1. To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
2. To analyze the time response of first and second order systems and improvement of performance by proportional plus derivative and proportional plus integral controllers
3. To investigate the stability of closed loop systems using Routh's stability criterion and the analysis by root locus method.
4. To present the Frequency Response approaches for the analysis of Linear time Invariant (LTI) systems using Bode plots, polar plots and Nyquist stability criterion.
5. To discuss basic aspects of design and compensation of linear control systems using Bode plots.
6. Ability to formulate state models and analyze the systems. To present the concepts of Controllability and Observability.

Course Outcomes:

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Derive the transfer function for Linear Time Invariant (LTI) systems by using block diagram and signal flow graph methods	Derive (2)	1, 2
CO2	Analyze the Transient & Steady State Performance for LTI system	Analyze (4)	1, 2
CO3	Acquires the skill to analyze stability of LTI systems using different stability methods	Analyze (4)	1, 2
CO4	Design the controllers/compensators for LTI systems and Also represent physical systems as state models and their responses. Describe the concepts of controllability and observability.	Design(5)	1, 2, 3, 12

Unit-I:

Mathematical Modeling of Control Systems:
Classification of control systems, Open Loop and closed loop control systems and their differences, Feed-Back Characteristics, transfer function of linear system, Differential

equations of electrical networks, Translational and Rotational mechanical systems, Transfer Function of DC Servo motor - AC Servo motor- Synchro, transmitter and receiver - Block diagram algebra – Representation by Signal flow graph - Reduction using Mason's gain formula.

Outcomes:

- Represent mathematical model and transfer function for any given systems.

Activity/Event:

- Finding mathematical model and transfer function for any given systems using MATLAB Software.

Unit-II:

Time Response Analysis:

Standard test signals - Time response of first and second order systems - Time domain specifications - Steady state errors and error constants – Effects of proportional derivative, proportional integral systems.

Outcome:

- Analyze the Transient & Steady State Performance for first and second order system

Activity/Event:

- Finding the time domain response & time domain specifications for any Given systems using MATLAB Software.

Unit-III:

Stability Analysis:

The concept of stability – Routh's stability criterion –limitations of Routh's stability –Root locus concept - construction of root loci (Simple problems)
Introduction to Frequency domain specifications-Bode diagrams- transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots, Polar Plots, Nyquist Stability criterion.

Outcome:

- Analyze the stability, Phase Margin & Gain Margin for any given system using various methods (root locous,bode plots, polar plots & Nyquist plots).

Activity/Event:

- Finding the stability, Phase Margin & Gain Margin for any given system using various methods (root locous, bode plots, polar plots & Nyquist plots) using MATLAB Software.

Unit-IV:

Classical Control Design Techniques:
Lag, Lead, Lag-Lead compensators, design of compensators – using Bode plots. Analysis and tuning of conventional controllers (P, PI,PD &PID)

Outcome:

- Design Lag, Lead, Lag-Lead compensators and PI,PD controllers for any given system.

Activity/Event:

- Design Lag, Lead, Lag-Lead compensators and PI, PD controllers for any given system using MATLAB Software.

Unit-V:

State Space Analysis of LTI Systems:

Concepts of state, state variables and state model, state space representation of transfer function, Diagonalization- Solving the time invariant state equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

Outcomes:

- Represent any given systems as state model and Analyze their response. Also understanding the concepts of controllability and observability.

Activity/Event:

- Finding state model for any given system using MATLAB Software.

Text Books:

1. Control Systems principles and design, M.Gopal, Tata McGraw Hill education Pvt. Ltd., 4th Edition.
2. Automatic control systems, Benjamin C.Kuo, Prentice Hall of India,2nd Edition

Reference Books:

1. Modern Control Engineering, Kotsuhiko Ogata, Prentice Hall of India.
2. Control Systems, Manik Dhanesh N, Cengage publications.
3. Control Systems Engineering, I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
4. Control Systems Engineering, S.Palani, Tata McGraw Hill Publications.

Course Code		L	T	P	Credits
1002172203	POWER GENERATION ENGINEERING & ECONOMICS	3	1	0	3

Course Overview:

This course aims at study of Power generating stations and Renewable energy sources and also Economics of power generation and Tariff methods.

Course Objectives:

1. To study the Line diagrams, components and layouts of Thermal and Hydroelectri Power Stations.
2. To study the concept of Nuclear and Gas Power Stations
3. To understand the concept of Energy scenario in India and world and also solar energ and its applications.
4. To understand the concept of Wind, Geothermal, Ocean energy, Fuel Cells.
5. To understand the concept of Economics of Power Generation and Tariff Methods.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the operation of different components of thermal and hydro power stations	Understand (2)	1
CO2	Explain the operation of different components of Nuclear, Gas Power Stations	Understand (2)	1, 3
CO3	Discuss the concepts of solar energy, the concepts of wind energy, geothermal, ocean energy and fuel cells	Understand (2)	1, 4, 7
CO4	Discuss the concept of Economics of Power Generation and determine different methods of tariff.	Understand (2)	1, 2

Unit-I:

Thermal and Hydroelectric Power Stations:

Line diagram of Thermal Power Station (TPS) showing paths of coal,steam, water, air, ash and flue gases- Brief description of TPS
Components: Economizers, Boilers, Super heaters, Turbines, Condensers, Chimney and

Cooling towers, ESP, Turbo-Generator features.
Hydro electric power Plant Layout, Classification, Components, Calculation of available Power, Hydrology, Hydroelectric Power Plant, Hydro electric generator features.

Outcome:

Students will be able to explain the operation of different components of thermal and hydro power stations.

Activity/Event: Activity on Generating stations layouts.

Unit-II:

Nuclear and Gas Power Stations

Nuclear Power Stations: Nuclear Fission and Chain reaction – Nuclear fuels - Principle of operation of nuclear reactor.-Reactor Components: Moderators, Control rods, Reflectors and Coolants. Types of Nuclear reactors and brief description of PWR, BWR and FBR and CANDU reactor Radiation Hazards: Shielding and Safety precautions.

Gas Power Stations: Principle of Operation and Components (Block Diagram Approach Only), Combined Cycle Power Plant.

Outcome: Students will be able to explain the operation of different components of Nuclear, Gas Power Stations.

Activity/Event: Activity on Nuclear and Gas Power Stations components

Unit-III:

Energy Scenario, Introduction to Solar energy and its Applications
Renewable Energy sources-Advantages-Energy Scenario in India and World.

Introduction to Solar Energy:
The Sun as a Source of Energy, Sun, Earth Radiation Spectrum, Extra terrestrial and Terrestrial radiations. Solar cell, Characteristics, Equivalent circuit, Module, array and panel construction. (No Numerical). Classification of solar collectors (Classification only), Types of concentrating collectors.
Solar Energy Applications: Solar Chimney, Solar air heater, Crop driers, solar ponds, water desalination (Principle of operation only)

Outcome: Discuss the concepts of solar energy and its applications.

Activity/Event: Activity on Energy scenario in India.

Unit-IV:

Wind, Geothermal, Ocean energy, Fuel Cells:

Introduction to Wind Energy:

Wind Energy, Nature of wind, Types of Wind turbines: Based on Axis of rotation and number of blades.

Geothermal Energy: Cross Section of earth, Hot dry rock Resources (HDR) (Principle of operation, No Numerical). Ocean Thermal Energy, Tidal Energy, Fuel Cells (Principle of Operation only)

Outcome: Illustrate the concepts of wind energy, geothermal, ocean energy and fuel cells.

Activity/Event: Activity on Fuel cells.

Unit-V:

Economics of Power Generation and Tariff Methods

Load curve, load duration and integrated load duration curves-load, Demand, diversity, capacity, utilization and plant use factors- (**No Numerical Problems).**
Costs of Generation and their division into Fixed, Semi-fixed and Running Costs, Desirable Characteristics of a Tariff Method, Tariff Methods- Flat Rate, Block-Rate, two-part, three – part, and power Factor tariff methods, Numerical Problems.

Outcome: Discuss the concept of Economics of Power Generation and determine different methods of tariff.

Activity/Event: Activity on Tariff methods.

Text Books:

1. M.L. Soni, P.V. Gupta, U.S. Bhatnagar and A. Chakraborti, *"A Text Book on Power System Engineering"*,2nd Edition, DhanpatRai& Co. Pvt. Ltd., 2010.[Unit-1,2,5]
2. B H Khan, "*Non-Conventional Energy Resources*," 3rd Edition, McGraw Hill Education [Unit-3,4]

Reference Books:

1. D. P. Kothari, K. C. Singal, RakeshRanjan, "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Learning Private Limited, 2011.
2. S P Sukhatme, "Solar Energy-Principles of thermal collection and storage," 2nd Edition, Tata Mcgraw-Hill Publishing company Limited.
3. M.V. Deshpande, *"Elements of Power Station Design and Practice"*, Wheeler Publishing,1979.
4. G. D. Rai, "Non-Conventional Energy Sources", 5th Edition, Khanna Publishers.

Course code	ANALOG ELECTRONICS	L	T	P	Credits
1002172204		3	1	0	3

Course Overview:

Analog Electronics is the most fundamental subject in the curriculum of electrical engineering Education. Analog electronics deals with, wave shaping circuits, switching characteristics of diode and transistor. Op-amp and Its various applications

Course Objectives:

1. To understand the concept of wave shaping circuits, switching characteristics of diode and transistor
2. Differentiate between Ideal and Non-Ideal Op-Amp, Determination of closed loop voltage gain, the input resistance, the output resistance for Non-Ideal Op-Amp Circuits.
3. Design waveform generators (Astable, Mono stable, Schmitt Trigger) using Single Op-Amp. Study of 555 timer & its applications using Astable and Mono stable Operations.
4. Can design various types of Active Filters such as LPF, HPF, BPF, BRF, NBPF, Notch Filter, ALL pass filters.
5. Study the operation & applications of PLA.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	After completion of this course student can able to differentiate "Analog Circuits & Digital Circuits".	Remember (1)	1, 2
CO2	The course content gives an insight in to the fundamentals so that one can design the "Linear Circuits" with their own innovative skills.	Apply (3)	2
CO3	They can design their own circuits which may be useful for current industry needs.	Design (6)	3, 4, 11, 12
CO4	Able to design various types of filters using Op-amp.	Design (6)	11, 12

Unit-I:

Linear and Non-linear Wave shaping:

Linear Wave Shaping: High pass, low pass RC circuits-response to sinusoidal, step, pulse, square and ramp inputs. RC circuit as differentiator and integrator.

Non linear wave shaping: Diode clippers, clippers at two independent levels-transfer characteristics of clippers, clamping operation, diode clamping circuits with source resistance and diode resistance -transient and steady state response for a square wave input.

Outcome: Student able to understand linear wave shaping and non-linear wave shaping Circuits.

Activity/Event: Design and testing of low and high pass filters using SPICE software.

Unit-II:

Introduction to Operation Amplifier and its Parameters:

Block diagram of Typical Op–Amp With Various Stages– BJT Differential Amplifier With RE DC Analysis– AC Analysis –BJT differential amplifier with constant current source – Analysis Different input/output configurations–AC analysis with r– parameters.
Input offset voltage – Input off–set current–Input bias current–Differential input resistance–Common mode rejection ratio–Slew ratio–PSRR–Large signal voltage gain–Output voltage swing transients response–definitions and explanations. Measurement of bias current–Measurement of offset currents– Measurement of offset voltage –Measurement of slew rate – Output offset voltage balancing circuits–Bias current compensations circuit.

Outcome:
Student able to know configuration of Op-amp and offsets contribution to output.

Activity/Event:
Design and testing OP-AMP using SPICE software.

Unit-III:

Ideal Operational Amplifier Theory and Basic Circuits:
Ideal operational amplifier properties–Ideal assumptions–Basic circuits such as non inverting type comparator–Inverting type comparator–Voltage follower– Inverting amplifier–Non–inverting amplifier–Summing amplifier– Non–inverting summing amplifier–sub-tractor– Differentiator–Integrator– Scale changer–Instrumentation amplifier– V to I and I to V convertors–Log and Anti–log amplifiers–Zero crossing detector–Schmitt-trigger peak detector– Half-wave and full-wave rectifiers– Precision diode– Non-ideal operational amplifier non–inverting amplifier– inverting amplifier– closedloop gain–Input and output resistance equivalent circuits.
Outcome: Student able to know how to use op-amp for different amplification applications and aligned ones.
Activity/Event: Design and testing of Differentiator and Integrator using OP-AMP.

Unit-IV:
Wave form generator in angular waveform generator using op–amps and PLL:
Design of Astable multi vibrator –Mono stable multi vibrator using signal op-amp–Trig ring waveform generator 555 timer: Introduction– Pin diagram–Functional diagram for 8pin DIP–Design of Astable and monostable multi– Astable application–Mono stable applications– PLL: Introduction, basic block diagram– Furctions of each block–566 VC0– 565 PLL block diagram –Function of each block–Applications of PLL–Frequency multiplier role of each pin frequency transalation– AM–FM and FSK demodulators**.**

Outcome: Student able to design multi vibrators and voltage controlled oscillator using op-amp.

Activity/Event: Design and testing of Mono stable multi vibrator using SPICE software**.**

Unit-V:

Active filters:

Introduction– Merits and demerits of active filters–Over passive filters– First order low pass Butter–Worth filter –Design and frequency response–Second order LPF design and frequency response – First order HPF design and frequency response– Second order HPF design and frequency response– Higher-order filters– BPF wide band–pass and narrow band–pass filter– Wide band reject filter–Notch filter–All-pass filter.

Outcome: Student able to design various types of filters using Op-amp**.**

Activity/Event: Design and testing of all pass filter using SPICE software.

Text Books:

1. OP–AMPS and liner integrator circuits by Ramakanth AGayakwad (PHI).
2. Linear Integrated Circuits by D.Roychowdary, New age international.
3. Op–amp and linear integrated circuits by sanjaysharma, S.K.Kataria& son's New Delhi.
4. Pulse and digital circuits –A anand Kumar, PHI,2005.

Reference Books:

1. Micro Electronics– Mclliman McGraw Hill.
2. Analog Electronics– L.K.Maheswari, PHI.
3. Linear Integrated circuits by S. Salivahan, TMH**.**

Course code		L	T	P	Credits
1002172205	**DATA STRUCTURES**	3	1	0	3

Course Overview:

Data Structure is a systematic way to organize data in order to use it efficiently. Following terms are the foundation terms of a data structure.

- Interface − Each data structure has an interface. Interface represents the set of operations that a data structure supports. An interface only provides the list of supported operations, type of parameters they can accept and return type of these operations.
- Implementation − Implementation provides the internal representation of a data structure. Implementation also provides the definition of the algorithms used in the operations of the data structure.

Course Objectives:

1. To be familiar with basic concepts of data structures.
2. Solve problems using linear data structures such as linear lists, stacks, queues.
3. Be familiar with advanced non-linear data structures such as balanced search trees.

Course outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Understanding the basic data structure concepts. And implementation of linear data structures using C.	Understand (2)	1, 4, 5
CO2	Apply various searching and sorting techniques in the area of performance.	Apply (3)	1, 2, 4, 5
CO3	Incorporate data structures into the non-linear representation.	Apply (3)	1, 2, 3, 4, 5
CO4	Implement advanced concepts in trees and their performance and tradeoffs.	Apply (3)	1, 2, 3, 4, 5

Unit-I:

Arrays and Linked Lists:

Abstract Data Types ADTs, Dynamic allocation of Arrays, Structures and unions, Polynomials, Spares Matrices Representation of multidimensional Arrays.
Single Linked List, Representing linked list in C, Polynomials and Polynomial Representation- Adding Polynomials- Circular List Representation of Polynomials, Doubly Linked Lists.

Outcome:

1. Understand primitive and non primitive data structures.
2. Design and apply appropriate data structures for solving computing problems.
3. Able to implement real time applications of arrays and Linked Lists.

Activity/Event:

Produce a node diagram that shows the removal of the first node in the ordered list.

Unit-II:

Stacks and Queues:

The Stack, Stacks using Dynamic Arrays, Recursion, The Queue, Circular Queues using Dynamic Arrays, Representation of Linked Stacks and Queues.
Application of stacks and queues, Evaluation of Expressions, Expression-Infix, Prefix and Postfix Notation. Conversion of Infix expression to postfix notation. Towers Of Hanoi Problem.

Outcome:

- Describe the design and implementations of Stacks and Queues.
- Identify the operations associated with the implementations of Stacks and Queues.
- Describe how stacks, queues, trees are represented in memory and used by algorithms

Activity/Event:

Assign the students to perform the following tasks to grab stacks operations:

- Create a new C project or program file containing the required declarations, such as the libraries to include, any constant declarations and the struct for the stack. You may need to declare an empty main(). Compile the program to check for typing errors. It is a feature of C that typing errors are easy to make. There should be no particular disgrace in making errors when programming in C, and you are advised to save and compile code at frequent intervals. As a C program can on occasion take a whole system down, you are also advised to take backups on a regular basis.
- Add the function prototypes and function bodies to the program. Recompile to check for errors, you may prefer to do this on a function-by-function basis.
- Add declarations to the main function. There should be at least one instance of the stack structure. Recompile to check your progress.

Unit-III:

Searching and Sorting: Searching: Linear Search, Binary Search, **Sorting:** Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort.

Outcome: Apply sorting and searching algorithms to the small and large data sets.

Activity/Event: Role Play:

Learning Outcomes:

a. To understand the concept of Time Complexity
b. Able to apply the time complexity theory to solve real life problems.

Problem statement*:* How to determine whether anyone in the room has the same Birthday as you?
Algorithm 1: You say your birthday, and ask whether anyone in the room has the same birthday. If anyone does have the same birthday, they answer yes.

Algorithm 2: You tell the first person your birthday, and ask if they have the same birthday; if they say no, you tell the second person your birthday and ask whether they have the same birthday; etc, for each person in the room.

Algorithm 3: You only ask questions of person 1, who only asks questions of person 2, who only asks questions of person 3, etc. You tell person 1 your birthday, and ask if they have the same birthday; if they say no, you ask them to find out about person 2. Person 1 asks person 2 and tells you the answer. If it is no, you ask person 1 to find out about person 3. Person 1 asks person 2 to find out about person 3, etc.

Activity Plan:

1. Tell students to demonstrate each algorithm in a group in front of the class. (10mins)
2. Ask Questions to the students:(10mins)
   - ✓ Question 1: For each algorithm, what is the factor that can affect the number of questions asked (the "problem size")?
   - ✓ Question 2: In the worst case, how many questions will be asked for each of the three algorithms?
   - ✓ Question 3: For each algorithm, say whether it is constant, linear, or quadratic in the problem size in the worst case. 3.
3. Assess the answers given by the students and finally display the correct solution.

Ans-1: The problem size is the number of people in the room.

Ans-2: Assume there are N people in the room. In algorithm 1 you always ask 1 question. In algorithm 2, the worst case is if no one has your birthday. Here you have to ask every person to figure this out. This is N questions. In algorithm 3, the worst case is the same as algorithm 2. The number of questions is 1 + 2 + 3 + ... + N-1 + N. We showed before that this sum is N (N+1)/2.

Ans-3: Given the number of questions you can see that algorithm 1 is constant time, algorithm 2 is linear time, and algorithm 3 is quadratic time in the problem size.

4. Ask students to Categorized the above solutions in terms of complexity in Best, Average and worst case.(5mins)
5. Display the correct answer.(2mins)
   Best- Algorithm1- O(1)
   Average- Algorithm2- O(N)
   Worst- Algorithm3- O(N^2)

Unit-IV:

Trees: Introduction, Terminology, Representation of Trees, Binary Trees, The Abstract Data Type, Properties of Binary Tress, Binary Tree Representations, Binary Tree Traversal and Tree Iterators, Introduction, In-order Traversal Pre-order Traversal, Post-order Traversal.

Binary Search Trees, Definition, Searching a Binary Search Tree, Insertion into a Binary Search Tree, Deletion from a Binary Search Tree, Height of Binary Search Tree.

Outcome:

- Understand the basic structure of binary trees
- Have a feel for how binary tree computations work locally: as recursive processes executed on a single node, "trusting" that child results are correct and independent of parent computations, all on a tree with a global form that is hidden from students
- Recognize that the typical graphical representation of binary trees is just one of many possible abstractions for understanding the trees.

Activity/Event:

Imagine a family tree with all generation relationship: grandparents, parents, children, siblings, etc. We commonly organize it in a hierarchical way. Draw on a Chart to identify nodes, edges.

Unit-V:

Graphs: The Graph Abstract Data Type, Introduction, Definition, Graph Representation, Elementary Graph Operation, Depth First Search, Breadth First Search, Connected Components, Spanning Trees, Biconnected Components, Minimum Cost Spanning Trees, Kruskal S Algorithm, Prim s Algorithm Sollin's Algorithm, Shortest Paths and Transitive Closure, Single Source/All Destination: Nonnegative Edge Cost, Single Source/All Destination: General Weights, All-Pairs Shortest Path, Transitive Closure.

Outcome: Implement all data structures like graphs.

Activity/Event: Seminar and Class Test.

Text Books:

1. Fundamentals of Data structures in C, S.Sahni, University Press (India) Pvt.Ltd, 2nd edition, Universities Press, Pvt. Ltd.
2. Data structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education. Ltd., Second Edition.
3. Data structures and Algorithms in C, Michael T.Goodrich, R.Tamassia and .Mount, Wiley student edition, John Wiley and Sons.

Reference Books:

1. Data Structures and algorithms in C++, 3rd edition, Adam Drozdeck, Thomson
2. Data Structures using C and C++, Langsam, Augenstein and Tenenbaum, PHI
3. Problem Solving with C++, The OOP, Fourth edition, Savitch, W.Pearson Education

Course code	MANAGERIAL ECONOMICS & FINANCIAL ANALYSIS	L	T	P	Credits
1099172106		3	1	0	3

Course Overview:

The present course is designed in such a way that it gives an overview of concepts of Economics. Managerial Economics enables students to understand micro environment in which markets operate how price determination is done under different kinds of competitions. Financial Analysis gives clear idea about concepts, conventions and accounting procedures along with introducing students to fundamentals of ratio analysis and interpretation of financial statements. Break Even Analysis is very helpful to the Business Concern for Decision Making, controlling and forward Strategic Planning. Ratio analysis gives an idea about financial forecasting, financial planning, controlling the business and decision making.

Course Objectives:

At the end of the course, the students will be able to:

1. Understand the concepts of managerial economics and the market dynamics namely Demand, Elasticity of demand and pricing in different market structures.
2. Acquire the knowledge about production theories and cost analysis besides dealing with the production and factors of production.
3. Analyze the different market structures and understand various pricing methods which are adopted in attracting the customers under different markets.
4. To understand various forms of business organization and business cycles, financial accounting, Capital and capital budgeting decisions.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe the economic activities performed by the businessmen in the business for profit earning. Understand the significance of demand, its analysis, measurement of demand and its Forecasting	Understand (2), Apply (3)	1, 2, 9
CO2	Evaluate the production theories and pricing policies of various enterprises	Understand (2)	1, 2
CO3	Design and implement different structures of market covering how price is determined under different market structures. Also can able to take decisions using business cycles	Analyze (4)	1, 2, 9
CO4	Analyze different forms of business organizations existing in the modern business and able to choose suitable form of business.	Understand (2)	4, 6
CO5	Able to prepare financial statements and understand and implement the capital budgeting tools and techniques.	Understand (2)	4

Unit-I:

Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve,

Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting.

Outcome:

1. Describe the economic activities performed by the businessmen in the business for profit earning. Understand the significance of demand, its analysis, measurement of demand and its Forecasting

Activity/Event: Presentations and object oriented tests

Unit-II:

Production and Cost Analyses: Concept of Production function- Cobb-Douglas Production function- Leontief production function - Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit analysis-Determination of Breakeven point(simple problems)-Managerial significance and limitations of breakeven point.

Outcome: Evaluate the production theories and pricing policies of various enterprises.

Activity/Event: Presentations and object oriented tests

Unit-III:

Part I: Introduction to Markets, Theories of the Firm & Pricing Policies: Managerial Theories of firm: Marris and Williamson's models – Significance of Pricing and various methods of pricing with contemporary examples. Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price andOutput Determination.

Part II: Types of Business Organization and Business Cycles: Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and theirforms – Business Cycles : Meaning and Features – Phases of Business Cycle.

Outcome:

Design and implement different structures of market covering how price is determined under different market structures. Also can able to take decisions using business cycles.

Activity/Event: Presentations and object oriented tests

Unit-IV:

Introduction to Accounting and Capital Budgeting Decisions: Part I: Introduction to Accounting, Double Entry Systems Journal, Ledger, Trail Balance, preparation of Financial Statements (Problems)

Outcome: Analyze different forms of business organizations existing in the modern business and able to choose suitable form of business

Activity/Event: Presentations and object oriented tests

Unit-V:

Capital Budgeting Decisions: Classification of Capital- Methods of appraising Project profitability: Traditional Methods (Payback period, Accounting rate of return) and Time value of money- Modern methods (Net Present Value method, Internal Rate of Return Method and Profitability Index Method) - Problems

Outcome:

Able to prepare financial statements and understand and implement the capital budgeting tools and techniques.

Activity/Event: Presentations and object oriented tests

Text Books:

1. M.Kasi Reddy & Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 10th Revised Edition, 2012.
2. Varshney & Maheswari, "Managerial Economics", Sulthan Chand Publishers, 1st Revised Edition, 2009.
3. S.N. Maheshwari & S.K.Maheshwari, "Financial Accounting", Vikas Publication House Pvt.Ltd, 4th Edition, 2012.

Reference Books:

1. D.N. Dwivedi, "Managerial Economics", Vikas Publication House Pvt.Ltd, 2nd Edition, 2012.
2. R.Narayana Swamy, "Financial Accounting- A managerial Perspective", Pearson publications, 1st Indian Reprint Edition, 2012.
3. J.V.Prabhakar Rao & P.V.Rao, "Managerial Economics & Financial Analysis", Maruthi Publishers, 1st Revised Editon, 2011

Course Code	ELECTRICAL MACHINES-II LABORATORY	L	T	P	Credits
1002172221		0	0	3	2

Course Objectives:

1. To control the speed of three phase induction motors.
2. To determine /predetermine the performance three phase and single phase induction motors.
3. To improve the power factor of single phase induction motor.
4. To predetermine the regulation of three–phase alternator by various methods, find X_d/ $X_q$ratio of alternator and asses the performance of three–phase synchronous motor.

1. Brake test on three phase Induction Motor
2. No–load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three–phase alternator by synchronous impedance & m.m.f. Methods
4. Performance and Characteristics of BLDC motor
5. V and Inverted V curves of a three—phase synchronous motor.
6. Determination of X_d and X_q of a salient pole synchronous machine
7. Equivalent circuit of single phase induction motor
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three phase alternator by loading with three phase induction motor.
10. Power factor improvement of single phase induction motor by using capacitors and load test on single phase induction motor.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Able to assess the performance of single phase and three phase induction motors	Assess (6)	1, 2, 3, 9, 10
CO2	Able to control the speed of three phase induction motor.	Analyze (4)	1, 2, 3, 9, 10
CO3	Able to predetermine the regulation of three–phase alternator by various methods	Determine (6)	1, 2, 3, 9, 10
CO4	Able to find the X_d/ $X_q$ratio of alternator and asses the performance of three–phase synchronous motor.	Assess (6)	1, 2, 3, 9, 10

Course Code	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	Credits
1002172222		0	0	3	2

Course Objectives:

1. To study basic electronic components
2. To observe characteristics of electronic devices

List of Experiments:

1. P-N Junction Diode Characteristics
   Part A: Germanium Diode (Forward bias& Reverse bias) Part B: Silicon Diode (Forward Bias only)
2. Zener Diode Characteristics Part A: V-I Characteristics
   Part B: Zener Diode as Voltage Regulator
3. Rectifiers (without and with c-filter) Part A: Half-wave Rectifier
   Part B: Full-wave Rectifier
4. BJT Characteristics(CE Configuration) Part A: Input Characteristics
   Part B: Output Characteristics
5. FET Characteristics(CS Configuration) Part A: Drain Characteristics
   Part B: Transfer Characteristics
6. SCR Characteristics
7. UJT Characteristics
8. Transistor Biasing
9. CRO Operation and its Measurements
10. BJT-CE Amplifier
11. Emitter Follower-CC Amplifier
12. FET-CS Amplifier

Learning outcomes: At the end of the course the students can able

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	To Measure voltage, frequency and phase of any waveform using CRO.	Apply (3)	1,2,3,4,5,6,7,9,11, 12
CO2	Analyze the characteristics of different electronic devices such as diodes, transistors etc., and simple circuits like rectifiers, amplifiers etc.,	Create (6)	1,2,3,4,5,6,7,9,11, 12

Course Code	INDUSTRIAL VISIT	L	T	P	Credits
1002172231		0	0	0	2

Industrial Visit: The industrial visit shall be carried out in their domain during the summer vacation after the second year second semester. A student has to submit a report which will be evaluated for 100 marks and will be submitted to an internal evaluation committee comprising Head of the Department or his / her nominee and two senior faculty of the department including the industrial visits coordinator/ supervisor. The industrial visit report shall be evaluated at the beginning of third year first semester before the first mid-term exams**.** Industry oriented MOOCs course (including NPTEL/ Coursera) for not less than EIGHT weeks can be considered as equivalent. The list of courses in such case shall be approved by Head of the department concerned. The registered course must not be same as any of the courses listed in the program structure of their regulation till final year. Marks/grades are awarded based on the performance in viva voce or written examination conducted for Coursera courses and online courses other than SWAYAM/NPTEL where there is no end examination.

PROGRAM STRUCTURE

FOR

III B.TECH

I &II SEMESTERS

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
PROGRAM STRUCTURE

Class: III B.Tech I Semester

S.No	Course Code	Course Title	L	T	P	Credits
1	1002173101	Power transmission Engineering	3	1*	0	3
2	1002173102	Signals and Systems	3	1*	0	3
3	1002173104	Electrical Measurements	3	1*	0	3
4	1099172203	Management Science	3	1*	0	3
5	1002173105	Power Electronics	3	1*	0	3
6	1002173106	Digital Electronics	3	1*	0	3
7	1002173121	Power Electronics Lab	0	0	3	2
8	1002173122	Control Systems Lab	0	0	3	2
9	1002173123	Data Structures Lab	0	0	3	2
Total Credits:						24

Class: III B.Tech II Semester

S.No	Course Code	Course Title	L	T	P	Credits
1	1002173201	Power Electronic Controllers &Drives	3	1*	0	3
2	1002173202	Power System Analysis	3	1*	0	3
3	1002173203	Renewable Energy Systems	3	1*	0	3
4	1002173204	Microprocessors and Microcontrollers (MPMC)	3	1*	0	3
5	**Elective – I:**		3	1*	0	3
	1002173205	1.Electric Vehicles				
	1002173206	2.Optimization Techniques				
	1002173207	3.Instrumentation				
	1002173208	4.Special Electrical Machines				
6	**Open Elective – I:**		3	1*	0	3
	1005173207	1.Introduction to Python Programming				
	1003173203	2.Robotics				
	1002173209	3.Neural Networks & Fuzzy Logic				

	1002173210	4.Energy Audit and conservation & Management				
7	1002173221	Electrical Measurements Lab	0		3	2
8	1002173222	Microprocessors and Microcontrollers (MPMC) Lab	0		3	2
9	1099172103	Professional Ethics & Human Values	2		0	0
Total Credits:						**24**

S.No	Course Code	Course Title	L	T	P	Credits
1	1002173241	Industry Oriented Mini Project	0		0	2

Course Code	POWER TRANSMISSION	P	T	P	Credits
1002173101	ENGINEERING	3	1	0	3

Course Overview:

This course is an extension of Power generation Engineering and Economics. It deals with basic theory of transmission lines modeling and their performance analysis. Transient in power system, improvement of power factor and voltage control are discussed in detail. It is important for the student to understand the mechanical design aspects of transmission lines, underground cables, insulators. These aspects are also covered in detail in this course.

Course Objectives:

- To compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.
- To study the short and medium length transmission lines, their models and performance.
- To study the performance and modeling of long transmission lines.
- To study the effect of travelling waves on transmission lines.
- To study the factors affecting the performance of transmission lines and power factor improvement methods.
- To discuss sag and tension computation of transmission lines as well as to study the performance of overhead insulators.

Course outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Apply parameters of various types of transmission lines during different operating conditions	Apply (3)	1
CO2	Analyze the performance of short and medium transmission lines.	Analyze (4)	2
CO3	Investigate travelling waves on transmission lines.	Investigate (5)	2, 3
CO4	Summarize various factors related to charged transmission lines and underground cables.	Analyze (4)	1

UNIT–I:

Transmission Line Parameters

Conductor materials - Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for single phase and three phase– Single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor configuration with and without transposition–Bundled conductors-Numerical Problems–Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Capacitance calculations for

symmetrical and asymmetrical single and three phase–Single and double circuit lines- Bundled conductors–Numerical Problems.

Outcome: To compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.

Activity/Event : Calculate the GMR/GMD of the given transmission line.

UNIT-II:

Performance of Transmission Lines

Classification of Transmission Lines – Short, medium, long lines – their model representations, evaluation of A,B,C,D Constants, mathematical Solutions to estimate regulation and efficiency of all types of lines – Numerical Problems.

Outcome: Student will be able to analyze the performance of short and medium transmission lines**.**

Activity/Event: To model a given transmission line in MATLAB/ SIMULINK.

UNIT-III:

Waves in Long Transmission Lines and Power System Transients:

Long Transmission Lines– Incident, Reflected and Refracted Waves –Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves.
Types of System Transients – Travelling or Propagation of Surges –Attenuation–Distortion– Reflection and Refraction Coefficients – Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions**.**

Outcome: Student will be able to investigate travelling waves on transmission lines.

Activity/Event: To analyze the transient behavior in a given long transmission line.

UNIT-IV:

Various Factors Governing the Performance of Transmission Line and Underground Cables:

Skin and Proximity effects – Description and effect on Resistance of Solid Conductors – Ferranti effect – Charging Current –Shunt Compensation –Corona – Description of the phenomenon– Factors affecting corona–Critical voltages and power loss – Radio Interference.
Underground Cables: Types of cables, capacitance of single-core cable, grading of cables, power factor and heating of cables, capacitance of 3-core belted cable, D.C. Cables.

Outcome: Student will be able to summarize various factors related to charged transmission lines and underground cables**.**

Activity/Event : Collect the data of any underground cable network.

UNIT-V:

Sag , Tension Calculations and Overhead Line Insulators:

Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor–Numerical Problems – Stringing chart and sag template and its

applications–Types of Insulators – String efficiency and Methods for improvement– Numerical Problems – Voltage distribution–Calculation of string efficiency–Capacitance grading and Static Shielding.

Outcome: Student able to estimate sag/tension of transmission lines, performance of line insulators**.**

Activity/Event : Collect the stringing charts and sag template.

Text Books:

1. Electrical power systems – by C.L.Wadhwa, New Age International (P) Limited, Publishers, 1998.
2. Modern Power System Analysis by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 2ndEdition**.**

Reference Books:

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4thedition.
2. Power System Analysis and Design by B.R.Gupta, Wheeler Publishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar A.Chakrabarthy, DhanpatRai& Co Pvt. Ltd. Electrical Power Systems by P.S.R. Murthy,

Course Code		L	T	P	Credits
1002173102	SIGNAL & SYSTEMS	3	1	0	3

Course Overview:

This course deals with basic types of signals and systems and their analysis in time domain and frequency domain.

Course Objectives:

- Characterize the signals and systems and Concept of orthgonality.
- Analyze the continuous-time signals and continuous-time systems using Fourier series, Fourier transform and Laplace transform.
- Apply sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct back.
- Understand the relationships among the various representations of LTI systems
- Understand the Concepts of convolution, correlation
- Apply z-transform to analyze discrete-time signals and systems.

Course outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Able to understand the signals and systems and Concept of orthgonality	Understand (2)	1, 2
CO2	Analyze the continuous-time signals and continuous-time systems using Fourier series, Fourier transform	Analyze (4)	1, 2,
CO3	Can apply Laplace Transforms to continuous time signals and systems	Apply (3)	1, 2, 3
CO4	Can apply Z Transforms to discrete time signals and systems, applying sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct back.	Apply (3)	1, 2, 3

UNIT- I:

Introduction:

Definition of Signals and Systems, Operations on continuous time(CT) signals: time-shifting, time-scaling, amplitude-shifting, amplitude-scaling. Complex exponential and sinusoidal signals, Singularity functions and related functions: impulse function, step function signum function and ramp function. Orthogonality. Classification of signals: periodic-a periodic, even-odd, right sided-left sided, bounded-unbounded, energy-power, half wave symmetry, Representation of

waveform into signals. Discrete time (DT) signals , DT impulse, DT unit step, DT ramp signals. Operations on DT signals and analysis.

Outcome:

Operations on continuous and discrete signals and arithmetic operations of different signals

UNIT –II:

Analysis of Linear Systems:

Classification of Systems, Linear system, Response of a linear system, Linear time invariant (LTI) system, Linear time variant (LTV) system, Transfer function of a LTI system Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Filter characteristics of linear systems.. Cross-correlation and auto-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between convolution and correlation.

Outcome:

Can understand about the different types of systems and filters and their characteristics

UNIT –III:

Fourier Series and Fourier Transform:

Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Complex Fourier spectrum.
Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Introduction to Hilbert Transform.

Outcome:

Analyze the continuous-time signals and continuous-time systems using Fourier series, Fourier transform

UNIT –IV:

Laplace Transforms:

Review of Laplace transforms, Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Relation between L.T's, and F.T. of a signal. Laplace transform of certain signals using waveform synthesis, inverse Laplace transform.

Outcome: Can apply Laplace Transforms to continuous time signals and systems

UNIT – V:
Sampling Theorem

Sampling theorem, Graphical and analytical proof for Band Limited Signals, impulse sampling. Reconstruction of signal from its samples, effect of under sampling – Aliasing. Fundamental difference between continuous-time and discrete-time signals, discrete time signal representation using complex exponential and sinusoidal components, Periodicity of discrete time using complex exponential signal, Concept of Z- Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, properties of Z-transforms, Inverse Z-transform.

Outcome:

Apply sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct back.

Text Books:

1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.

2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn.

3. Signals & Systems- Narayan Iyer and K Satya Prasad, Cenage Pub.

Reference Books:

1. Signals & Systems – RAMESH BABU

Course Code		L	T	P	Credits
1002173104	ELECTRICAL MEASUREMENTS	3	1	0	3

Course Overview:

This course introduces principle of operation of basic analog and digital measuring instruments for measurement of current, voltage, power, energy etc. Measurement of resistance, inductance and capacitance by using bridge circuits will be discussed in detail. It is expected that student will be thorough with various measuring techniques that are required for an electrical engineer.

Course Objectives:

To study the principle of operation and working of different types of instruments. Measurement of voltage and current Power and energy.

1. To understand the principle of operation and working of dc and ac potentiometers and principle of operation and working of various types of magnetic measuring instruments.
2. To understand the principle of operation and working of various types of bridges for measurement of parameters –resistance, inductance, capacitance and frequency.
3. To study the applications of CRO for measurement of frequency, phase difference and hysteresis loop using Lissajous patterns, and also Study about the digital instruments in electrical measurements.

Course outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Choose right type of instrument for measurement of voltage and current for ac and dc and measurement of power and energy and also able to calibrate energy meter by suitable method.	Evaluate (6)	1,2,3,4,9
CO2	Calibrate ammeter voltmeter and potentiometer and also able to use the ballistic galvanometer and flux meter for magnetic measurements.	Apply (3)	1.2.3
CO3	Select suitable bridge for measurement of electrical parameters	Analyzing (4)	1,3
CO4	Measure frequency and phase difference between signals using CRO. able to use digital instruments in electrical measurements	Evaluate (6)	1,2,3,4

UNIT-1:

Measuring Instruments:

Classification – Deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type and dynamometer – Expression for the deflecting torque and control torque – Errors and compensations– Extension of range using shunts and series resistance – electrostatic instruments (basic principle of operation only) – CT and PT**:** Ratio and phase angle errors – Numerical problems.

Outcome:
Able to Choose right type of instrument for measurement of voltage and current for ac and dc.

Activity/Event: Measure Voltage and Current For AC and DC

UNIT-II:

Measurement of Power, Energy & Power Factor:

Measurement of Power
Single phase and three phase dynamometer wattmeter – LPF and UPF – Expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers

Measurement of Energy
Single phase induction type energy meter – Driving and braking torques – errors and compensations – Phantom loading– Three phase energy meter

Measurement of Power Factor – Single phase and three phase dynamometer type, power factor meter.

Outcome: Able to choose right type of instrument for measurement of power and energy - able to calibrate energy meter by suitable method

Activity/Event: Calibrate Energy Meter by using Standard meter

UNIT-III:

Potentiometers & Magnetic Measurements:

Potentiometers
Principle and operation of D.C Crompton's potentiometer–Standardization, Measurement of unknown resistance– Current – Voltage. AC Potentiometers polar and coordinate types – Standardization – Applications – Core loss measurements by potentiometers.

Magnetic Measurements
Ballistic galvanometer -Equation of motion – Flux meter- Constructional details Determination of B–H curve methods of reversals step by step method

Outcome: Able to calibrate ammeter voltmeter and potentiometer and able to use the ballistic galvanometer and flux meter for magnetic measurements.

Activity/Event: Calibrate Voltmeter & Ammeter using Potentiometer.

UNIT-IV:

Measurements of Parameters:

Method of measuring low, medium and high resistance –Wheat stone's bridge – Carey Foster's bridge– Kelvin's double bridge for measuring low resistance – Loss of charge method for measurement of high resistance – Megger – Measurement of earth resistance – Measurement of

inductance – Quality Factor – Maxwell's bridge – Hay's bridge – Anderson's bridge – Measurement of capacitance and loss angle – Desauty Bridge – Schering Bridge – Wagner's earthing device – Wien's bridge – Core loss measurements by bridges.

Outcome: Able to select suitable bridge for measurement of electrical parameters

Activity/Event: Measure Given Resistance, Inductance & Capacitance Value

UNIT -V:

Digital Meters:

Digital Voltmeter–Successive approximation Ramp and integrating Measurement of phase difference – Frequency Hysteresis loop using lissajious patterns in CRO type– Digital frequency meter–Digital multimeter – Digital Tachometer. Digital Energy Meter

Outcome: Able to measure frequency and phase difference between signals using CRO. Able to use digital instruments in electrical measurements.

Activity/Event: Measure the speed by using digital Tachometer & measure voltage , current & resistance by using digital Multimeter.

Text Books:

1. Electrical and Electronic Measurements and Instrumentation by A.K.Sawhney, Dhanpat Rai & Co. (Pvt.) Ltd. Delhi, 9thRevised edition-2011.
2. Electrical Machines by R.K.Rajput, Lakshmi publications,6th edition-2016.
3. Electrical Measurements and measuring Instruments – by E.W. Golding and F.C.Widdis, Wheeler Publishing. fifth Edition-2011.

Reference Books:

1. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.
2. Electrical Measurements – by Buckingham and Price, Prentice – Hall
3. Electrical Measurements by Forest K. Harris. John Wiley and Sons, Willy Eastern PVT. LTD.
4. Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited, Publishers-1989.
5. Electrical and Electronic Measurements –by G.K.Banerjee, PHI Learning Private Ltd, New Delhi–2012.

Course Code	MANAGEMENT SCIENCE	L	T	P	Credits
1099172203		3	0	0	3

Course Overview:

This course is intended to familiarize the students with the framework for the managers and leaders available for understanding and making decisions relating to issues related organizational structure, production operations, marketing, Human resource Management, product management and strategy.

Course Objectives:

1. To familiarize with the process of management and to provide basic insights into select contemporary management practices
2. To understand production process, quality control and inventory techniques
3. To know The nature and purpose of strategies and policies
4. To demonstrate functions of various functional areas

Course Outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Gives an outline of management and its nature scope and functions and hierarchical levels and organizational structure and managing the culture	Understand (2),	1, 2
CO2	Able to understand the various functions of production and inventory management	Understand (2)	1, 2
CO3	Bring out various concepts of strategic management and project management	Understand (2)	1, 2
CO4	Elucidate the process of matching manager qualifications with position requirements and concept of marketing mix	Analyze (4)	1, 2, 9

Unit-I:

Introduction to Management:

Concept –nature and importance of Management –Generic Functions of Management – Principles of Management – Evolution of Management thought- Theories of Motivation (Maslow's, hertz berg and X-Y Theory) – Decision making process-Designing organization structure- Principles of organization.

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Outcome: Gives an outline of management and its nature scope and functions and hierarchical levels and organizational structure and managing the culture

Unit-II:

Operations Management:

Plant location, Principles and Types of plant layout, production methods (job, batch mass production) – Work study- Statistical Quality Control- Control Charts (X Bar chart &R-charts, P-chart and C-chart) Simple problems- Material Management: Need for Inventory control- Tools and techniques of Inventory Control - EOQ, ABC analysis, HML, SDE, VED, and FSN analyses

Outcome: Able to understand the various functions of production and inventory management

Unit-III:

Strategic Management: Vision, Mission, Goals, Strategy – Elements of Corporate Planning Process –Environmental Scanning – SWOT analysis- Steps in Strategy Formulation and Implementation, Generic Strategy, Alternatives. Global strategies, theories of Multinational Companies.

Project Management: (PERT/CPM): Development of Network – Difference between PERT and CPM Identifying Critical Path- Probability (Problems)

Outcome: Bring out various concepts of strategic management and project management

Unit-IV:

Functional Management:

Concept of HRM, HRD and PMIR- Functions of HR Manager- Wage payment plans (Problems) – Job Evaluation and Merit Rating – Salient features of The Factories Act 1948 - Marketing Management, Marketing Mix strategies – Product, Price, Place and Promotion.

Outcome: Elucidate the process of matching manager qualifications with position requirements and concept of marketing mix

Unit-V:

Contemporary Management Practices:

Basic concepts of MIS, MRP, Justin- Time(JIT) system, Total Quality Management(TQM), Six sigma and Capability Maturity Model(CMM) Levies, Supply Chain Management ,Enterprise Resource Planning (ERP), Business Process outsourcing (BPO), Business process Re-engineering and Bench Marking, Balanced Score Card.

Outcome: Gives outline of various contemporary issues of management

Text Books:

1. Dr. P. Vijaya Kumar &Dr. N. Appa Rao, '*Management Science'* Cengage, Delhi, 2012.
2. Dr. A. R. Aryasri, *Management Science'* TMH 2011.

Reference Books:

1. Dr. P. Vijaya Kumar &Dr. N. Appa Rao, '*Management Science'* Cengage, Delhi, 2012.
2. Dr. A. R. Aryasri, *Management Science'* TMH 2011
3. Koontz &Weihrich: 'Essentials *of management'* TMH 2011
4. Seth & Rastogi: Global Management Systems, Cengage learning , Delhi, 2011
5. Robbins: Organizational Behaviour, Pearson publications, 2011
6. Kanishka Bedi: Production & Operations Management, Oxford Publications, 2011
7. Philip Kotler & Armstrong: Principles of Marketing, Pearson publications
8. Biswajit Patnaik: Human Resource Management, PHI, 2011

Course Code		L	T	P	Credits
1002173105	POWER ELECTRONICS	3	1	0	3

Course Overview:

This course covers characteristics of semiconductor devices, ac/dc, dc/dc, ac/ac and dc/ac converters. The importance of using pulse width modulated techniques to obtain high quality power supply (dc/ac converter) is also discussed in detail in this course.

Course Objectives:

1. To study the characteristics of various power semiconductor devices and to design firing circuits for SCR.
2. To understand the operation of single phase full–wave converters and analyze harmonics in the input current.
3. To study the operation of 3-Ph. full–wave converters.
4. To understand the operation of different types of DC-DC converters.
5. To understand the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation. To analyze the operation of AC-AC regulators

Course Outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the static and dynamic characteristics of various power semiconductor devices	Understand, apply	3 ,5
CO2	Distinguish the operation of single phase and three phase rectifiers.	Apply ,Create	3,5
CO3	Analyze the operation of different types of DC-DC converters.	Analyze	12
CO4	Distinguish the operation of AC-AC Converters	Apply ,Create	3,5

UNIT-I

Power Semi-Conductor Devices:

Thyristors–Silicon controlled rectifiers (SCR's) –Characteristics of power MOSFET, IGBT and TRIAC – Basic theory of operation of SCR–Static characteristics– Turn on and turn off methods–

Dynamic characteristics of SCR–Gate firing circuits of SCR , Basic requirements of gating circuits for SCR, IGBT and MOSFET , Snubber circuit design– problems

Outcome: To be able to understand the the static and dynamic characteristics of various power semiconductor

Activity/Event: Write the different ratings of the power device (SCR,MOSFET, IGBT).

UNIT-II:

AC-DC 1-Phase Controlled Converters:

1-phase half wave controlled rectifiers – R load and RL load with and without freewheeling diode – 1-phase Bridge type full wave controlled rectifiers with- R, RL & RLE load– continuous and discontinuous conduction – 1-ph.Semi converter with RL load- Effect of source inductance in 1-Phase fully controlled bridge rectifier with continuous conduction, Applications of AC to DC converters.

Outcome: Able to sketch the wave forms of single phase converters with R and RL Loads

Activity/Event: Design the 1-Phase rectifier with RLE load.

UNIT-III:

AC-DC 3-Phase Converters:

3-Phase half wave controlled rectifier with R and RL load & 3-Phase fully and controlled rectifier with R, RL and 3-Phase. semi controlled rectifier with R and RL load.

1-Phase Cyclo Converters:

Classification of the Cyclo Converters - Operation of the 1-Phase Step up and Step down Cyclo Converters with R & RL Loads..

Outcome: Able to understand the operation of three phase rectifiers and Cyclo converter

Activity/Event: Draw and explain the operation of the 3-Phase Half controlled rectifier with firing angle 120 degrees.

UNIT-IV:

Switched Mode DC–DC Converters:

Analysis of Buck, boost and buck-boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) – Output voltage equations using volt-sec balance in CCM & DCM , output voltage ripple & inductor current, ripple for CCM only- Applications of Switched mode DC-DC converters..

Outcome: Able to analyze the operation of different types of DC-DC converters

Activity/Event: Explain the operation regenerative braking of DC motor with boost Converter

UNIT -V:

DC–AC Converters:

1- Phase half bridge and full bridge inverters with R and RL loads, Single phase uni-polar and bipolar switching. – 3-phase square wave inverters – 120^0 conduction and 180^0 conduction modes of operation – PWM inverters – Quasi-square wave pulse width modulation – Sinusoidal pulse width modulation. Application of DC-AC Converters

AC – AC Regulators:

Modes of operation – 1-Phase Phase angle control of AC-AC regulator with R and RL load – For continuous and discontinuous conduction, Application of AC-AC converters

Outcome: Understand the operation of inverters and AC-AC regulators.

Activity/Event: Distinguish the operation of the 1.Phase AC voltage regulator with R & RL Load.

Text Books:

1. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
2. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India.

Reference Books:

1. Elements of Power Electronics–Philip T.Krein.oxford.
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.

Course Code		L	T	P	Credits
1002173106	DIGITAL ELECTRONICS	3	1	0	3

Course Overview:

This course deals with the introduction of digital logic and circuits, logic families, Boolean algebra design procedure of combinational circuits and introduction to the basic integrated circuits.

Course Objectives:

1. To understand the number systems and the Logic gates
2. To understand the minimization of logic functions.
3. To explain the realization of logic functions using combinational circuits.
4. To explain the design of counters, registers using Flip Flops.
5. To understand the different Logic families to produce different types of digital integrated circuits.

Course Outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Understand the conversion between different number systems, Binary Arithmetic and understand the logic gates and Minimization of Logic Functions.	Understand (2)	1
CO2	Realise Logic functions using multiplexers, encoders and decoders.	Apply (3)	3,12
CO3	Design different types of counters and different sequential circuits using flip flops**.**	Apply (3)	3,12
CO4	Realise Different Logic Gates with different logic Families.	Analyze (4)	3,12

UNIT-1:

Number Systems, Codes and Logic Gates:

Number Systems-Types-Decimal, Binary, Octal, Hexadecimal; Conversion from one number system to other; Binary arithmetic operations; Representation of Negative Numbers;1's complement and 2's complement, Complement arithmetic; Digital Codes -Excess-3 code, Gray code, BCD code, code conversion, ASCII code, Error Detection Codes-Hamming code. Logic Gates-Basic Gates, Universal Gates and realization of other gates using universal gates.

Outcome: Able to do conversion between different number systems, Binary Arithmetic and understand the logic gates.

Activity/Event: Using Diodes Realize AND, OR, NOT gates on bread board.

UNIT-2:

Minimization Techniques:

Rules and laws of Boolean algebra, Demorgan's Theorems, Boolean Expressions and Truth Tables, Standard SOP and POS forms; Min term and Max terms, Canonical representation, Duality Theorem, Minimization Techniques of Switching functions using Karnaugh Map(up to 4 variables) and Boolean algebra.

Outcome: Able to Minimize the Logic Functions.

Activity/Event: Minimize Logic functions of 5 variables using K-maps.

UNIT-3:

Combinational Circuits-Part 1 :

Introduction to combinational Circuits, Adders-Half-Adder and Full-Adder, Subtractors- Half and Full Subtractor; Parallel adder and Subtractor; Ripple Carry and Look-Ahead Carry Adders; BCD adder, BCD Subtractor.

Combinational Circuits- Part 2 :

Multiplexer, De-multiplexer, Encoder, Priority Encoder; Decoder, Active high and Active low concepts, BCD to Seven segment Display Decoder, Parity Checker/Generator; Comparator, realization of Boolean functions using decoders and multiplexers. PROM, PAL, PLA-Basic structures, merits & demerits, realization of Boolean functions using PAL, PLA.

Outcome: Able to Realize Logic functions using multiplexers, encoders and decoders.

Activity/Event: List the IC manufacturers and IC numbers of MUX, De-MUX, Encoders, and Decoders.

UNIT-4:

Sequential Circuits:

Introduction to Sequential Circuits, Latches, Flip-Flops: Types of Flip Flops -RS, T, D, JK; Triggering of Flip Flops; Flip Flop conversions; Master-Salve JK. Shift Registers, types of shift registers, Bidirectional Shift Registers.

Counters: Types of Counters-Asynchronous and synchronous counters, Design of Mod-n synchronous counters.

Outcome: Able to Design different types of counters and different sequential circuits using flip flops.

Activity/Event: List different types of analog to digital converters and manufacturers with IC numbers

UNIT -5:

Logic Families:

Definition of parameters-current voltage parameters, Fan in, Fan out, Noise Margin, Propagation Delay, Power Dissipation; Resistor Transistor Logic(RTL),Diode Transistor Logic (DTL), Transistor-Transistor Logic (TTL); Emitter Coupled Logic (ECL),C-MOS Logic; Comparison of Various Logic Families.

Outcome: Able to Realize Different Logic Gates with different logic Families.

Activity/Event: List the Digital IC manufacturers and different Digital IC manufacturing processes.

Text Books:

1. Mandal, Digital Electronics: Principles and Applications, TMH.
2. M. Morris Mano, Digital Logic and Computer Design, Pearson Edu.
3. Digital electronics by RP jain, THM.

Reference Books:

1. Digital electronics principles, devices and applications, by Anil K Maini, john Wiley &sons limited.
2. Fundamentals Of Digital Circuits by A. Anand Kumar, 3rd edition, EEE, PHI publications

Course Code		L	T	P	Credits
1002173121	POWER ELECTRONICS LAB	0	0	3	2

Course objectives:

- To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- To analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- To understand the operation of AC voltage regulator with resistive and inductive loads.
- To understand the working of Buck converter, Boost converter and inverters.

Course outcomes:

After the completion of course student will be able to

CO	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the characteristics of various power electronic devices and analyze gated rive circuits of IGBT.	Analyze (4)	12
CO2	Analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.	Analyze (4)	3
CO3	Describe the operation of single phase AC voltage regulator with resistive and inductive loads.	Apply (3)	3, 5
CO4	Illustrate the working of Buck converter, Boost converter, single–phase square wave inverter and PWM inverter.	Apply (3)	3, 5

Any 10 of the Following Experiments are to be conducted

1. Study of Characteristics of Thyristor, MOSFET & IGBT.
2. Design and development of a firing circuit for Thyristor.
3. Design and development of gate drive circuits for IGBT.
4. Single -Phase Half controlled converter with R and RL load
5. Single -Phase fully controlled bridge converter with R and RL loads

6. Single -Phase AC Voltage Regulator with R and RL Loads
7. Single -Phase square wave bridge inverter with R and RL Loads
8. Three- Phase fully controlled converter with RL–load.
9. Design and verification of voltages gain of Boost converter in Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode(DCM).
10. Design and verification of voltages ripple in buck converter in CCM and DCM operation.
11. Single -phase PWM inverter with sine triangle PWM technique.
12. 3-phase AC-AC voltage regulator with R-load.

Course Code		L	T	P	Credits
1002173122	CONTROL SYSTEMS LAB	0	0	3	2

Course Overview:

In Control System Laboratory basic components of the control systems, working of P, PI, PID controllers in real time, design of compensators using frequency response in MATLAB are introduced at basic level.

Course Objectives:

1. To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, DC. servo motors, AC. Servo motors, stepper motor and potentiometer.
2. To understand time and frequency responses of control system with and without controllers and compensators using MATLAB Simulation.

Course outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Analyze the performance and working Magnetic amplifier, DC and AC. servo motors and Synchro Transmitter and Receiver.	Analyze (4)	12
CO2	Determine the transfer function of a DC Motor and Compare P, PI, PD and PID controllers.	Apply (3)	3
CO3	Understand the working of PID controller in temperature control application and position control systems.	Apply (3)	3,5
CO4	Design lag, lead compensators by using simulation	Create (6)	3,5

Any 10 of the following experiments are to be conducted:

1. Time response of Second order system- MATLAB Simulation and Experiment using CRO.

2. Characteristics of Synchro Transmitter & Receiver.
3. Effect of feedback on DC servo motor.
4. Effect of P, PD, PI, PID Controller on a second order systems- MATLAB Simulation & Experiment.
5. DC position control system.
6. Transfer function of DC motor- MATLAB Simulation & Experiment.
7. Temperature control using PID - MATLAB Simulation & Experiment.
8. Characteristics of magnetic amplifiers.
9. Characteristics of AC servo motor & DC servo motor.
10. Potentiometer as an error detector.
11. Drawing Bode plot, Root Locus, and Nyquist plot of a system in MATLAB.
12. Design of Lag and lead compensators for a system in frequency domain using MATLAB.

Course Code		L	T	P	Credits
1002173123	DATASTRUCTURES THROUGH C LAB	0	0	3	2

Course Objectives:

- To develop skills to design and analyze simple linear and non linear data structures
- To Strengthen the ability to identify and apply the suitable data structure for the given real w rld problem
- To Gain knowledge in practical applications of data structures

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Practical knowledge on the application of data structures	Understand (2)	1
CO2	Design and develop programs for linear data structures	Apply (3)	2, 4, 5
CO3	Design and develop programs for non linear data structures	Understand (2)	1, 4, 5
CO4	Develop programs for various sorting techniques	Analyze (3)	1, 2, 3, 5

List of Experiments:

1. Develop C programs to implement the following using an array
   a) Linear search b) binary search
2. Develop a C Program to find number of comparisons and swapping for a given list of numbers
   a) Bubble Sort b) Selection Sort
3. Develop a c program to implement Merge Sort
4. Develop a c program to implement Quick Sort
5. Develop C programs to implement Stack using an array.
6. Develop C programs to implement Queue using an array.
7. Develop a C program to do the following

a) Infix to postfix conversion. b) Evaluation of postfix expression.

8. Implementation of single linked list.
9. Implementation of Doubly linked list.
10. Implement Stack using linked list.
11. Write C programs that use recursive functions to traverse the given binary tree in

    a) Pre-order b) In-order c) Post-order.
12. Implementation of Binary Search trees.

Text Books:

1. Fundamentals of Data structures in C, S.Sahni, University Press (India) Pvt.Ltd, 2nd edition, Universities Press, Pvt. Ltd.
2. Data structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education. Ltd., Second Edition.

Course code		L	T	P	Credits
1002173201	POWER ELECTRONIC CONTROLLERS & DRIVES	3	1	0	3

Course Overview:

This course is an extension of power electronics applications to electric drives. This course covers in detail the basic and advanced speed control techniques using power electronic converters that are used in industry. It is equally important to understand the four quadrant operation of electric drives and slip power recovery schemes in induction motors.

Course Objectives:

- To learn the fundamentals of electric drive and different electric braking methods.
- To analyze the operation of 1-Ø converter controlled dc motors and four quadrant operation of dc motors using dual converters.
- To understand the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
- To learn the principles of static rotor resistance control and various slip power recovery schemes.
- To understand the speed control mechanism of synchronous motors.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the fundamentals of electric drive and different electric braking methods	Explain (2)	1, 6, 7
CO2	Analyze the speed control DC motors through controlled converters (1-Ø) and choppers.	Analyze (4)	1, 6, 7
CO3	Differentiate the stator side control and rotor side control of three phase induction motor using power converters.	Differentiate (4)	1, 6, 7
CO4	Describe VSI, PWM techniques to control the synchronous motor.	Describe (4)	1, 6, 7

UNIT-I:

Fundamentals of Electric Drives:

Block diagram of Electric drive & Advantages – Fundamental torque equation – Load torque components – Nature and classification of load torques– Steady state stability – Four quadrant operation of drive (hoist control) – Braking methods for DC shunt & series motor **:** Dynamic – Plugging – Regenerative method

Outcome: To be able to Explain the fundamentals of electric drive and different electric braking methods.

Activity: To find and brief some practical applications of Drives used in industries.

UNIT-II:

Controlled Converter Fed DC Motor Drives:

1-phase half and fully controlled converter fed separately excited and series DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics — Principle of operation of dual converters and dual converter fed DC motor drives - Numerical problems.

DC–DC Converters Fed DC Motor Drives:

Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited & DC series motors – Continuous current operation– Output voltage and current waveforms – Speed–torque characteristics –Four quadrant operation – Closed loop operation (qualitative treatment only)

Outcome: Student able to Analyze the speed control DC motors through controlled converters (1 phase) and choppers.

Activity: Simulate 1-phase rectifier fed DC motor using any simulation tool

Unit-III:

Stator side control of 3-phase Induction motor Drive:

Introduction to soft starters & applications - Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics – Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop v/f control of induction motor drives (qualitative treatment only).

Outcome: Student able to describe the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.

Activity: conduct on V/f control of induction motor in machines lab.

Unit-IV:

Rotor side control of 3-phase Induction motor Drive:

Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static

Kramer drive – Performance and speed torque characteristics – Advantages –Application

Outcome: Summarize stator side and rotor side control techniques of an induction motor

Activity: Prepare a chart summarizing all rotor side control methods.

Unit-V:

Control of Synchronous Motor Drives:

Separate control & self-control of synchronous motors – Operation of self-controlled synchronous motors by VSI– Closed Loop control operation of synchronous motor drives (qualitative treatment only).–Variable frequency control–Pulse width modulation.

Outcome: Student able to Describe VSI, PWM techniques to control the synchronous motor

Activity: Prepare a presentation on control aspects of synchronous machine.

Text Books:

1. Fundamentals of Electric Drives – by G K Dubey , Narosa Publications
2. Power Semiconductor Drives, by S.B.Dewan, G.R.Slemon, A.Straughen, Wiley- India Edition.

Reference Books:

1. Electric Motors and Drives Fundamentals, Types and Apllications, by Austin Hughes and Bill Drury, Newnes.
2. Thyristor Control of Electric drives – VedamSubramanyam Tata McGraw Hill Publications.
3. Power Electronic Circuits, Devices and applications by M.H.Rashid, PHI
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier.

Course Code		L	T	P	Credits
1002173202	POWER SYSTEM ANALYSIS	3	1	0	3

Course Overview:

This course is designed to give students the required knowledge for the design and analysis of electrical power grids. Calculation of power flow in a power system network using various techniques, formation of Z-bus and its importance are covered in this course. It also deals with short circuit analysis and analysis of power system for steady state and transient stability

Course Objectives:

1. To development the impedance diagram (p.u) and formation of Y-bus & Z-bus.
2. To study the different load flow methods.
3. To study short circuit calculation for symmetrical & unsymmetrical faults and their effects.
4. To study the rotor angle stability of power systems.

Course outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Compute the per unit values of system and formulate Y-bus for a given power system network	Compute (2)	1, 2
CO2	Calculate the load flows in a power systems using various numerical methods.	Calculate (3)	1, 2, 3,4
CO3	Compute Z-bus for a given power system network and analyze symmetrical fault calculation	Apply (3)	1, 2, 3,6,7
CO4	Solve an un-balanced three phase network by using symmetrical components and analyze a power system under fault conditions.	Solve (3)	1, 2, 3,6,7
CO5	Analyze the steady state and transient stabilities	Analyze (4)	1,2,3,6

UNIT-I:

Per Unit Representation & Y–Bus Formulation:

Per Unit Representation Per Unit Quantities–Single line diagram– Impedance diagram of a power system– Y–Bus formulation Formation of bus incidence matrix – Primitive network representation Formation of Y–bus matrix by singular transformation and direct inspection methods.

Outcome: To be able to Compute the per unit values of system and formulate Y-bus for a given power system network

Activity/Event: Determine the Y-Bus for the IEEE standard 5 bus system

UNIT-II:

Power Flow Studies:
Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (polar coordinates form) – Decoupled and Fast Decoupled methods – Algorithmic approach –Comparison of Power Flow Studies. Problems on 3–bus system only.

Outcome: Student able to Calculate the load flows in a power system using various numerical methods.

Activity/Event : Conduct Load flow studies of IEEE standard 5 bus system using MATLAB

UNIT-III:

Z–Bus Formulation & Symmetrical Fault Analysis:

Z–Bus formulation:
Formation of Z-Bus: Partial network, Algorithm for modification of Z-Bus matrix for addition of element in the following cases: new bus to reference, new bus to old bus, old bus to reference and between two old busses Modification of Z-Bus

Symmetrical Fault Analysis:
Transients on a Transmission line-Short circuit of synchronous machine(on no-load) 3–Phase short circuit currents and reactances of synchronous machine Short circuit MVA calculations, Series reactors & selection of reactors Fault current calculation using Z-bus Impendence matrix.

Outcome: Student able to Compute Z-bus for a given power system network and analyze symmetrical fault calculation.

Activity/Event: write a MATLAB code to form a Z-bus for a standard IEEE 5 bus test system

UNIT-IV:

Unsymmetrical Fault Analysis:

Definition of symmetrical components – symmetrical components of unbalanced three phase systems – Power in symmetrical components – Sequence impedances – Synchronous generator – Transmission line and transformers – Sequence networks – Various types of faults LG– LL– LLG and LLL on unloaded alternator–unsymmetrical faults on power system

Outcome: Student able to solve an un-balanced three phase network by using symmetrical components and analyze a power system under fault conditions.

Activity/Event: create different faults using MATLAB simulink and observe the fault currents and voltages with wave forms

UNIT-V:

Power System Stability Analysis:

Elementary concepts of Steady state– Dynamic and Transient Stabilities– Description of Steady State Stability Power Limit–Transfer Reactance–Synchronizing Power Coefficient – Power Angle Curve and Determination of Steady State Stability –Derivation of Swing Equation–Solution of Swing Equation by point by point method Determination of Transient Stability by Equal Area Criterion– Applications of Equal Area Criterion– Methods to improve steady state and transient stability

Outcome: Student able to analyze the steady state and transient stabilities.

Activity/Event: find the stability of a power system using power angle characteristics of an alternator using MATLAB simulink**.**

Text Books:

1. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', Tata McGraw-Hill Publishing Company, New Delhi, 1990.
2. Jhon J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', McGraw Hill International Book Company, 1994

Reference Books:

1. C.L. Wadhwa, 'Electrical Power Systems', New age International-3rd Edition
2. Hadi Saadat, "Power System Analysis", McGraw Hill, 3rd edition, 2011.
3. M.A. Pai, "Computer Techniques in Power System Analysis", TMH Publications, 2nd Edition, 2000.
4. O.I. Elgerd, "Electric Energy Systems Theory", Tata McGraw-Hill, 2nd Edition, 2005.

Course code		L	T	P	Credits
1002173203	RENEWABLE ENERGY SYSTEMS	3	1	0	3

Course Overview:

This course deals with the basic solar radiation measurements, thermal systems, Photovoltaic Systems. Wind energy aerodynamics, electrical machines for renewable energy conversion. Analysis of wind and PV systems, Hybrid renewable energy systems

Course Objectives:

- To study and understand various solar radiation measuring devices and solar radiation geometry
- To understand solar photovoltaic systems and MPPT techniques
- To understand and study wind energy aerodynamics and machines for renewable systems
- To study and understand standalone and grid interactive wind and PV systems
- To understand various types of hybrid renewable energy systems

Course outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	To be able to analyze solar radiation geometry and thermal systems	Analyze (4)	2, 6, 7
CO2	To be able to design solar PV systems	Design (6)	3, 6, 7
CO3	To be able to understand various electrical machines for renewable energy systems	Understand (2)	1, 6, 7
CO4	To be able to analyze standalone and grid connected wind and PV systems	Analyze (4)	1, 6, 7

UNIT-I:

Solar Energy Basics and Thermal Systems:

Introduction: Classification of energy resources, Salient features of non-conventional energy sources.
Solar energy basics: Depletion of solar Radiation-Absorption, Scattering, Measurements of solar radiation-Pyranometer, Pyrheliometer, Sunshine recorder, Solar radiation data, Solar time, Solar radiation geometry (Numericals), Radiation of tilted surfaces.
Solar Thermal Systems: Liquid flat plate collectors: Performance Analysis-Transmissivity Absorptivity product-collector efficiency factor–Collector heat removal factor.
Distributed collector solar thermal electric power plant (Principle of operation with schematic diagram)

Outcome: To be able to analyze solar radiation geometry and thermal systems

Activity/Event: Design of Sunshine recorder

UNIT-II:

Solar Photovoltaic Systems:

Solar Cell I-V Characteristics, Maximizing the solar PV output and load matching, Classification of solar PV Systems-Standalone solar PV system, Grid interactive solar PV system, Balance of system components.
Design: storage sizing-PV system sizing, Maximum power point techniques: Perturb and observe (P&O) method, Incremental conductance method

Outcome: To be able to design solar PV systems

Activity/Event: Implementation of P & O algorithm using MATLAB

UNIT-III:

WIND TURBINE AERODYNAMICS

Origin of winds, Variation of wind speed with height and time, Wind energy program in India. Energy estimation of wind, Power extraction from Wind-Betz Criterion-Tip Speed ratio.
Reference theory Fundamentals: Principle of operation and analysis: IG, PMSG, SCIG, and DFIG

Outcome: To be able to understand various electrical machines for renewable energy systems

Activity/Event: Prepare a report on wind energy generation and utilization in Andhra Pradesh

UNIT-IV:

Analysis of Wind And PV Systems:

Standalone operation of fixed and variable speed wind energy conversion systems and solar Systems-Grid connected Issues-Grid integrated PMSG, SCIG based WECS, Grid integrated solar system.

Outcome: To be able to analyze standalone and grid connected wind and PV systems

Activity/Event: To study generation and grid integration of VIIT solar power generation

UNIT-V:

Hybrid Renewable Energy Systems:

Need for Hybrid systems-Range and type of hybrid systems-Case studies of Wind-PV Maximum Power Point Tracking system (MPPT**)**

Outcome: To be able to understand necessity and types of hybrid renewable energy systems

Activity/Event: To carry out a case study on wind-PV MPPT

Text Books:

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
2. Non-conventional energy source –B.H. Khan- TMH-2nd edition.
3. S. N. Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009
4. Gray, L. Johnson, "Wind energy system", prentice hall, 1995. Delhi.

Reference Books:

1. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 5th Edition, 2004.
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006

Course code		L	T	P	Credits
1002173204	MICROPROCESSORS AND MICROCONTROLLERS (MPMC)	3	1	0	3

Course Overview:

This course deals with the basic architecture, assembly language programming, pin definitions, supporting chips and memory interfacing of microprocessors and microcontrollers.

Course Objectives:

The objective of the course is to understand various addressing modes, different peripheral devices and their interfacing with 8085, 8086 and 8051.

- To understand the organization and architecture of Micro Processors.
- To understand addressing modes to access memory
- To understand 8051 micro controller architecture
- To understand the programming principles for 8086 and 8051
- To understand the interfacing of MP with IO as well as other devices

Course outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	To be able to explore the architecture of microprocessors and microcontrollers	Remember (1)	2
CO2	Select a microprocessor or a microcontroller suitable for the given application	Understand (2)	3, 4
CO3	Write assembly language program in 8086 and 8051 for various applications	Apply (3)	3, 10, 11, 12
CO4	Create necessary memory and I/O interfacing with 8086 and 8051	Create (6)	4, 5 , 12

Unit-I:

Introduction To Micro Computer System And 8-Bit Microprocessors:

Block diagram representation of microcomputer system / microprocessors and the role of various functional units, 8085 Microprocessor architecture, Clock, Memory, Bus systems, Pin description, Interrupts and Instruction set, Programming of 8085.

Outcome: To be able to understand the micro computer system and its basic operation.

Activity/Event: Write an assembly language program for 8085.

Unit-II:

16-BIT Microprocessors:

8086 microprocessor architecture, Pin Configuration, Minimum and Maximum mode operations of 8086, 8086 Control signal interfacing–Read and write cycle timing diagrams. Instruction set, Addressing modes, Programming of 8086.

Outcome: Student able to understand the micro processor capability

Activity/Event: Debug given assembly language programs.

Unit-III:

Interfacing With 8086:

Memory interfacing with 8086, I/O interfacing with 8086, 8255 PPI architecture, Modes, Interfacing of different I/O devices (LEDs, Display units, ADC,DAC, Stepper motor) using 8255, Basic architecture of 8259 interrupt controller, 8257 DMA controller and their applications.

Outcome: Student able to interface micro processor with other electronic devices.

Activity/Event: Make working I/O interfaces.

Unit-IV:

Micro Controllers:

Architecture of 8051 microcontroller, Signals, I/O ports and Memory Organization, Timers and Counters, Serial Communication, Interrupts, Addressing modes, Instruction set and simple programs for 8051

Outcome: Student able to program micro controller

Activity/Event: Develop one application program for 16 bit microprocessor.

Unit-V:

I/O Interfacing with Micro Controller:

Programming 8051; LED interfacing, Seven segment interfacing, ADC, DAC, Sensor interfacing, Stepper motor interfacing.

Outcome: Student able to program micro controller for various industrial applications.

Activity/Event:

Develop interfacing circuit for any one industrial application and write a coding for that.

Text Books:

1. Microprocessor architecture, programming, and applications with the *8085* by Ramesh S Gaonkar.
2. Ray and Burchandi, "Advanced Micro Processors and Interfacing", Tata McGraw– Hill.
3. Kenneth J Ayala, "The 8051 Micro Controller Architecture, Programming and Applications", Thomson Publishers, 2nd Edition.

Reference Books:

1. Microprocessors and Interfacing, Douglas V Hall, Mc–Graw Hill, 2nd Edition.
2. Ajay V. Deshmukh, "Microcontrollers – Theory and Applications", Tata McGraw–Hill Companies –2005.

Course Code		L	T	P	Credits
1002173205	ELECTRIC VEHICLES	3	1	0	3

Course Overview:

This course deals with the fundamental concepts, principles, analysis and design of electric vehicles. It also discusses various aspects of electric and hybrid electric drive trains, their configuration, types of electric machines, power electronics, energy storage devices, charging infrastructure, etc.

Course Objectives:

The objective of the course is to understand general aspects of Electric and Hybrid Electric Vehicles, including architectures, modeling, sizing, sub-system design and hybrid vehicle control. It will cover vehicle dynamics, energy storage sources, electric propulsion systems, power electronics design, and vehicle control and communication.

- To understand the concepts and drive train configurations of electric drive vehicles
- To understand different electric propulsion systems and energy storage devices.
- To understand the technology, design methodologies and control strategy of electric and hybrid electric vehicles
- To understand battery charger topologies for plug in hybrid electric vehicles

Course outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the concepts and drive train configurations of electric drive vehicles.	Understand (2)	1, 6, 7
CO2	Describe different electric propulsion systems and energy storage devices	Remember (1)	1
CO3	Discuss the technology, design methodologies and control strategy of electric vehicles.	Discuss (6)	3, 7
CO4	Explain battery charger topologies for electric vehicles and discuss how the sizing of the drive system is done and energy management strategies used in electric.	Understand (2)	1, 7

UNIT-I:

Introduction to Electric Vehicles:

Environmental and Social impact of Electric Vehicles (EVs), History of EVs, Impact of modern drive-trains on energy supplies.

Conventional Vehicles: Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance.

Outcome: Explain the importance of electric vehicles for sustainable development and discuss basic vehicle operation.

Activity/Event: List out different companies which are manufacturing electric vehicles.

UNIT-II:

Hybrid Electric Drive-Trains:

Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

Electric Drive-trains: Basic concept of electric traction, Introduction to various electric drive-train topologies, power Flow control in electric drive-train topologies, Fuel efficiency analysis.

Outcome: Describe various electric drive-train and hybrid drive-train topologies.

Activity/Event: Write a report collecting all electric and hybrid electric vehicle models.

UNIT-III:

Electric Propulsion Unit:

Introduction to electric components used in electric and hybrid electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, Drive system efficiency.

Outcome: Discuss the configuration and control of DCM Drives, IM Drives, PMM Drives, SRM Drives.

Activity/Event: Deliver a technical seminar on Configuration and Control of various types of drives used in electric vehicles.

UNIT-IV:

Energy Storage:

Introduction to Energy Storage Requirements in Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Outcome: Describe and analyze various types of energy storage devices employed in electric vehicles.

Activity/Event: Collect the details of various commercially available energy storage devices used in electric vehicles.

UNIT-V:

Sizing the Drive System:

Matching the Electric Machine and the Internal Combustion Engine (ICE), Sizing the propulsion motor, Sizing the power electronics, Selecting the energy storage technology, Communications, Supporting subsystems

Energy Management Strategies: Introduction to energy management strategies used inelectric and hybrid electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies, Implementation issues of energy management strategies.

Outcome: Discuss sizing of the drive system and energy management strategies used in electric and hybrid electric vehicles.

Activity/Event: Design and develop a prototype model of BEV/HEV.

Text Books:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
3. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 2003.
4. NPTEL Web Course Material on 'Hybrid and Electric Vehicles".

Reference Books:

1. Gianfranco, "Electric and Hybrid Vehicles: POWER SOURCES, MODELS, SUSTAINABILITY, INFRASTRUCTURE AND THE MARKET", Pistoia Consultant, Rome, Italy, 2010.
2. Chris MI, M. Abul and David Wenzhong Gao, "Hybrid Electrical Vehicle Principles and Application with Practical Perspectives", John Wiley & Sons Ltd., 2011.
3. John M. Miller, "Propulsion System for Hybrid Vehicle", 2nd Edn.
4. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Cengage Learning, 2012.
5. SerefSoylu "Electric Vehicles - The Benefits and Barriers",InTechPublishers, Croatia, 2011.
6. Jack Erjavec and Jeff Arias, "Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles", Cengage Learning Pvt. Ltd., New Delhi, 2007
7. Seth Leitman, "Build Your Own Electric Vehicle", McGraw hill, NewYork, USA 2013.

Course Code		L	T	P	Credits
1002173206	OPTIMIZATION TECHNIQUES	3	1	0	3

Course Overview:

Optimization techniques have gained importance to solve many engineering design problems by developing linear and nonlinear mathematical models. The aim of this course is to educate the student to develop a mathematical model by defining an objective function and constraints in terms of design variables and then apply a particular mathematical programming technique. This course covers classical optimization techniques, linear programming, nonlinear programming and Swarm Optimization algorithms.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.	Understand (2)	1, 2, 3
CO2	To solve single variable and multi variable optimization problems, without and with constraints.	Apply (3)	1, 2, 3, 4
CO3	To apply linear and non-linear programming technique to an optimization problem.	Apply (3)	1, 2, 3, 4
CO4	To explain basic principles of Genetic Algorithms and Particle Swarm Optimization methods	Understand (2)	1, 2, 3, 4, 5

UNIT–I:

Introduction and Classical Optimization Techniques:

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Outcome:

To classify Optimization problems and design constraints.

Activity/Event:

To collect Optimization problems in various fields of engineering.

Unit-II:

Classical Optimization Techniques

Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

Outcome:

Students will be able to analyse single variable and multi variable optimization problems.

Activity/Event: To study single variable and multi variable optimization problems.

Unit-III:

Linear Programming

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm - Duality in Linear Programming – Dual Simplex method.

Outcome:

Student able to formulate a mathematical model and apply linear programming technique by using Simplex method.

Activity/Event:

To develop code &/or flowchart for simplex method, Dual Simplex method.

Unit-IV:

Nonlinear Programming:

Unconstrained cases - One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method - Univariate method, Powell's method and steepest descent method.

Constrained cases - Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

Outcome: Students will be able to apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions.

Activity/Event: To execute constrained cases and unconstrained cases of Nonlinear Programming in software.

Unit-V:

Introduction to Swarm Intelligence Systems:

Swarm intelligence programming methods - Basic Partial Swarm Optimization – Method – Characteristic features of PSO procedure of the global version – Parameters of PSO (Simple PSO algorithm – Operators selection criteria – Fitness function constraints) – Comparison with other evolutionary techniques – Engineering applications of PSO.

Outcome: Students will be able to solve problems using PSO.

Activity/Event: To solve Economic Load Dispatch using PSO.

Text Books:

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
2. Soft Computing with Matlab Programming by N.P.Padhy&S.P.Simson, Oxford University Press – 2015

Reference Books:

1. "Optimization methods in operations Research and Systems Analysis" by K.V.Mitaland C.Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Genetic Algorithms in search, optimization, and Machine Learning by David E.Goldberg,ISBN:978-81-7758-829-3, Pearsonby Dorling Kindersley (India) Pvt. Ltd.
3. "Operations Research: An Introduction" by H.A.Taha, PHI pvt. Ltd., 6th edition.
4. Linear Programming by G.Hadley.

Course Code	INSTRUMENTATION	L	T	P	Credits

1002173207 **3 1 0 3**

Course Overview:

Electrical and Electronic Instrumentation plays a key role in the industry. With the Advancement of technology day to day manual maintenance is replaced by simply monitoring using various instruments. Thus this course plays very important role in overall maintenance of the industry.

Course Objectives:

The objective of the course is to understand working Principles of various Transducers, Oscilloscopes and various types of signals and measurement of various Non-electrical quantities

- To study various types of signals and their representation.
- To study various types of transducers: Electrical, Mechanical, Electromechanical, Optical etc.
- To study and measure the various types of Non–electrical quantities.
- To understand the working principles of various types of oscilloscopes and their applications
- To study various types of signal analyzers

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Able to represent various types of signals.	Remember (1)	1
CO2	Acquire proper knowledge to use various types of Transducers	Apply (3)	1,2,3
CO3	Able to monitor and measure various parameters such as velocity, temperature, pressure etc.	Monitor (4)	1,2,3
CO4	Able to measure various parameter like phase and frequency of a signal with thehelp of CRO	Analyze (4)	1, 2,3,4,5

UNIT-I:

Characteristics of Signals :

Measuring Systems, Performance Characteristics, – Static characteristics – Dynamic Characteristics – Errors in Measurement – Gross Errors – Systematic Errors – Statistical analysis of random errors

Signal and their Representation:

Standard test, periodic, a periodic, modulated signal – Sampled data pulse modulation and pulse code modulation.

Outcome: Student can able to represent various types of signals.

Activity/Event : Sampled data pulse modulation and pulse code modulation using MATLAB

UNIT-II:

Transducers:

Definition of transducers – Classification of transducers – Advantages of Electrical transducers – Characteristics and choice of transducers – Principle operation of resistor, inductor, LVDT and capacitor transducers – LVDT Applications – Strain gauge and its principle of operation – Guage factor – Thermistors – Thermocouples – Synchros – Piezo electric transducers – Photo diodes.

Outcome: Student canacquire proper knowledge to use various types of Transducers.

Activity/Event : Measurement of displacement using LVDT

UNIT-III:

Measurement of Non–Electrical Quantities:

Displacement – Velocity – Angular Velocity – Acceleration – Force – Torque – Measurement of Temperature, Pressure, Vacuum, Flow, Liquid level.

Outcome: Student can able to monitor and measure various parameters such as velocity, temperature, pressure etc

Activity/Event: Measurement of displacement using Non electrical Transducer.

UNIT-IV:

Oscilloscope:

Cathode ray oscilloscope – Time base generator – Horizantal and vertical amplifiers – Sampling oscilloscope – Analog and digital type data loger – Transient recorder.

Outcome: Student can able to measure various parameter like phase and frequency of a signal with the help of CRO

Activity/Event: phase angle measurement using lissajous patterns

UNIT-V:

Signal Analyzers:

Wave Analyzers – Frequency selective analyzers – Heterodyne – Application of Wave analyzers – Harmonic Analyzers – Total Harmonic distortion – Vector impedance meter – Q meter – Peak reading voltmeters.

Outcome: Student can acquire proper knowledge and able to handle various types of signal analyzers

Activity/Event: Measurement of THD by using MATLAB

Text Books:

1. Electronic Instrumentation–by H.S.Kalsi Tata MCGraw–Hill Edition, 1995.
2. A course in Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, Dhanpatrai & Co.

Reference Books:

1. Measurement and Instrumentation theory and application, Alan S. Morris and Reza Langari, Elsevier
2. Measurements Systems, Applications and Design – by D O Doeblin
3. Principles of Measurement and Instrumentation – by A.S Morris, Pearson/Prentice Hall of India
4. Modern Electronic Instrumentation and Measurement techniques – by A.D Helf rickand W. D. Cooper, Pearson/Prentice Hall of India.
5. Transducers and Instrumentation by D.V.S Murthy, Prentice Hall of India.

Course Code		L	T	P	Credits
1002173208	SPECIAL ELECTRICAL MACHINES	3	1	0	3

Course Overview:

This is an advanced course on electrical machines. Students will be exposed to various special machines which are gaining importance in industry. This course covers topics related to principles, performance and applications of these special machines including switched reluctance motors, stepper motors, permanent magnet dc motors and linear motors

Course Objectives:

- To describe the operation and characteristics of permanent magnet dc motor.
- To explain the performance and control of stepper motors, and their applications.
- To explain theory of operation and control of switched reluctance motor.
- To explain about different types of brush less dc motors**.**
- To explain the theory of travelling magnetic field and applications of linear motors.

Course outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the performance and control of stepper motors, and their applications	Apply (3)	1, 2, 3
CO2	Explain theory of operation and control of switched reluctance motor.	Analyze (4)	1, 2
CO3	Describe the operation of BLDC motors.	Analyze (4)	1, 2
CO4	Explain the theory of travelling magnetic fields and applications of linear motors.	Understand (2)	1, 2

UNIT-I:

Stepper Motors:

Construction and principle of operation of Variable Reluctance Motor (VRM) – Single stack and multiple stack – Open loop control of 3- phase VR Stepper Motor;

Construction and principle of hybrid stepper motor – Different configuration for switching the phase windings control circuits for stepper motors – Open loop control of 2-phase hybrid stepping motor; Closed loop control of stepper motor; Applications

Outcome: Explain the performance and control of stepper motors, and their applications.

Activity/Event: Design a control circuit for stepper motor(Hardware)

UNIT-II:

Switched Reluctance Motors:

Construction; Principle of operation; Design of stator and rotor pole arcs; Torque producing principle and torque expression ; Different converter configurations for SRM; Drive and power circuits for SRM, Position sensing of rotor with hall probes; Applications of SRM.

Outcome: Explain theory of operation and control of switched reluctance motor.

Activity/Event: Simulate the different converter configurations for SRM in MATLAB/SIMULINK

UNIT-III:

Permanent Magnet Materials and PMDC Motors:

Permanent-magnet materials and characteristics; B-H loop and demagnetization characteristics; Temperature effects: reversible and irreversible losses-high temperature effects-reversible losses-Irreversible losses recoverable by magnetization; Mechanical properties, handling and Magnetization; Application of permanent magnets in motors-power density-operating temperature range-severity of operation duty. Stator frames of conventional PM dc motors, Development of electronically commutated dc motor from conventional dc motor**.**

Outcome: Describe the properties of different magnetic materials

Activity/Event: Collect different permanent magnet materials Unit-IV: BLDC Motors

UNIT-IV:

BLDC Motors:

Types of construction; Principle of operation of BLDC motor; Sensing and switching logic scheme: Sensing, Logic controller, Lockout pulses; Drive and power circuits: Base drive circuit, Power converter circuit; Methods of reducing torque pulsations: 1800 pole arc and 1200 current sheet.

Outcome: Describe the operation of BLDC motors.

Activity/Event: Submit a brief report on control of BLDC motors

UNIT-V:

Linear Induction Motors (LIM):

Double sided LIM from rotating type Induction Motor –Schematic of LIM drive for traction – Development of one sided LIM with back iron; Equivalent circuit of LIM.

Outcome: Explain the theory of travelling magnetic field and applications of linear motors.

Activity/Event: Simulate the equivalent circuit of LIM in Matlab/Simulink

Text Books:

1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989, Oxford.
2. Special electrical Machines, K.VenkataRatnam, University press, 2009, New Delhi.

Reference Books:

1. Special Electrical Machines, E.G.Janardhan

Course Code		L	T	P	Credits
1005173207	INTRODUCTION TO PYTHON PROGRAMMING	3	1	0	3

Course Overview:

This course introduces computer programming using the Python programming language which will help you to master the Programming with Python by introducing the Object Oriented programming concepts, creation of Data Structures, Implementation of Functions, and Visualization libraries. Lastly you will get into design, code, test, and debug Python programming Language Scripts.

Course outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Install Python IDE and run basic Python scripts.	Understand (2)	1
CO2	Understand the operators, functions, key Concepts of Object Oriented Programming in python.	Understand (2)	1, 2
CO3	Access Python from various online resources and import packages to the current working environment.	Apply (3)	5
CO4	Develop front end GUI using Visualization Libraries and Multithreading techniques.	Analyze (4)	12

Unit-I:

Introduction:

History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

Types, Operators and Expressions:

Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations.

Outcome:

- Understand the Introduction of Python IDE.
- Learn the basics building blocks of python.
- Write the basic programs in python.
- Learn the different types of operators in python

Activity/Event:

Install Python on PCs or through Mobile applications run basic Python Scripts for a given data.

Unit-II:

Control Flow-:if, if-elif-else, for, while, break, continue, pass

Data Structures Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions.

Outcome:

- Understand the syntax of conditional statements in python
- Understand the syntax of Data Structures in python

Activity/Event:

Identify Operators and types in Python. Implement Data Structure concepts by writing Python Scripts.

Unit-III: Functions

Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

Modules: Creating modules, import statement, from, name spacing,

Python packages Introduction to PIP, Installing Packages via PIP, Using Python Packages

Outcome:

- Understanding Functions implementation using Python.
- Learn the scope or life time of variables in a function.
- Usage of import statement in modules.
- Create a package, import and install PIP package in python.

Activity/Event :

Using Functions develop simple scripts in Python Programming.

Unit-IV:

Object Oriented Programming OOP in Python: Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding.

Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions

Outcome:

- Implement the OOP concepts using python
- Understand the Exception handling in python.

Activity/Event:

Implement OOP concepts in Writing Python Scripts

Unit-V:

File handling: Python File(doc and csv) Operation Reading config files in python, Writing log files in python, Understanding read functions, Understanding write functions, Manipulating file pointer using seek ,Programming using file operations
Introduction to Standard libraries: NumPy, Pandas

Outcome:

- Understand standard Libraries and GUI visualization in Python.

Activity/Event :

Write various test cases and implement specific test for a given case study.

Text Books:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly
3. Complete Reference to Python – TMH-2018
4. Python Programming - Using Problem Solving Approach, Reema Thereja, Oxford University Press

Reference Books:

1. Think Python, Allen Downey, Green Tea Press
2. Core Python Programming, W.Chun, Pearson.
3. Introduction to Python, Kenneth A. Lambert, Cengage
4. http://nptel.ac.in/courses/117106113/34
5. https://www.python.org/

Course Code		L	T	P	Credits
1003173203	ROBOTICS	3	1	0	3

Course Overview:

The course is focused on robots in industrial automation with kinematic and dynamic analysis of manipulators. It also explains the need for automation in industry by discussing the concepts of robot actuators and feedback mechanisms with applications.

Course Objectives:

1. To give students practice in applying their knowledge of mathematics, science, and Engineering and to expand this knowledge into the vast area of robotics.
2. The students will be exposed to the concepts of robot kinematics, Dynamics, Trajectory planning.
3. Mathematical approach to explain how the robotic arm motion can be described.
4. The students will understand the functioning of sensors and actuators.

Course outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Identify various robot configuration and components.	Understand (2)	1, 5, 6, 7, 8
CO2	Select appropriate actuators and sensors for a robot based on specific application.	Apply (3)	2, 3, 4, 6, 11
CO3	Carry out kinematic and dynamic analysis for simple serial kinematic chains.	Analyze (4)	2, 3, 4, 7, 12
CO4	Perform trajectory planning for a manipulator by avoiding obstacles.	Evaluate (6)	1, 2, 3, 4, 5, 8, 9, 10, 11, 12

Unit-I:

Introduction:

Automation and Robotics, – An over view of Robotics – Classification by coordinate system and control system.

Components of the Industrial Robot:

Common types of arms. Components, Architecture, number of degrees of freedom –

Requirements and challenges of end effectors, determination of the end effectors.

Outcome: 1**.** Types of robots and arms.
2**.** Various classification of robots

Activity: Demo on mechatronics system in mechatronics lab.

Unit-II:

Motion Analysis:

Homogeneous transformations as applicable to rotation and translation – problems.

Manipulator Kinematics:

Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

Outcome: 1.Transformations of robot arms.
2. Kinematics of manipulators

Activity: Demo on transformations using simulation mode in cad/cam lab.

Unit-III:

Differential Transformation And Manipulators, Jacobians – problems

Dynamics: Lagrange – Euler and Newton – Euler formulations – Problems.

Outcome: Manipulator dynamics using jacobians.

Activity: Video representing of kinematic and dynamic analysis with simulation.

Unit-IV:

General Considerations in path description and generation. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages-description of paths with a robot programming language.

Outcome: 1.Trajectory planning with via points.
2. Determination of displacement, velocity and acceleration for a curve.

Activity: Demo of linear and circular interpolation with algorithms.

Unit-V:

Robot Actuators And Feed Back Components: Actuators: Pneumatic,Hydraulic Electrical actuators–comparison. Electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

Robot Applications in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

Outcome: 1. Difference between various actuating systems.
2. Planning for various manufacturing methods.

Activity: Demo of Electric, pneumatic and hydraulic system.

Text Books:

1. Industrial Robotics / Grover M P, M Weiss, R N Nagel, N G Odrey, Ashish Dutta/ Pearson Edu.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.

Reference Books:

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall.
3. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter Science.
4. Introduction to Robotics / John J Craig / Pearson Edu.

Course Code **NEURAL NETWORK AND** **L T P Credits**

1002173209 **FUZZY LOGIC** **3 1 0 3**

Course Overview:

This is a course where neural networks and fuzzy logic techniques so called artificial intelligence techniques are used in electrical engineering applications.

Course Objectives:

- To understand artificial neuron models.
- To utilize different algorithms of ANN.
- To distinguish between classical and fuzzy sets.
- To understand different modules of fuzzy controller.
- To understand applications of neural networks and fuzzy logic.

Course outcome:

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Know different models of artificial neuron, Use learning methods and different paradigms of ANN.	Apply (3)	1,2,3,4
CO2	Classify between classical and fuzzy sets.	Understand (2)	1
CO3	Use different modules of Fuzzy logic controller.	Apply (3)	2,3,4
CO4	Apply Neural Networks and fuzzy logic for real-time applications.	Analyzing (4)	1,2,3,4,5

UNIT – I:

Introduction to Neural Networks:

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, Historical Developments, Potential, Applications of ANN. McCulloch-Pitts Model, Spiking Neuron Model,

Essentials of Artificial Neural Networks:

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised,

Reinforcement), Learning Rules, Types of Application.

Outcome:

To be able to understand the concept of neural networks and its essential parts, architectures, learning rules and learning strategies.

Activity: Write the transformation of the artificial neuron from the biological neuron.

UNIT- II:

Multi-layer Feed Forward Neural Networks:

Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements, Radial Basis Function (RBF) Neural Network – Kohonen Self Organising feature Map (KSOM).

Associative Memories:

Bidirectional Associative Memories (BAM)-Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network, Summary and Discussion of Instance/Memory Based Learning Algorithms, Applications.

Outcome: Student able to understand the multilayer feed forward networks and associate memories.

Activity: Identifying various multilayer feed forward networks.

UNIT – III:

Classical & Fuzzy Sets:

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

Outcome:

Student able to understand the concept of fuzzy sets and membership. Student able to understand the operations and properties of fuzzy sets.

Activity: Solving various problems on operations and properties of the fuzzy sets.

UNIT IV:

Fuzzy Logic Modules:

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

Outcome:

Student able to understand the Fuzzification, Rulebase, Decision Making and the Defuzzification.

Activity: Develop one application by using Fuzzification, Rulebase, Decision Making and the

Defuzzification.

UNIT V:

Applications:

Neural network applications: Fault diagnosis and load forecasting. Fuzzy logic applications: Load frequency control and Speed Control of DC Motor.

Outcome:

Student able to apply the knowledge of the neural networks and fuzzy logic in especially Electrical Engineering Applications.

Activity: Develop one application based on neural networks and fuzzy logic.

Text Books:

1. Neural Networks – Simon Hakins , Pearson Education
2. Fuzzy Logic with Engineering Applications – Timothy J Ross, John Wiley & Sons Ltd.
3. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication

Reference Books:

1. Introduction to Neural Networks using MATLAB 6.0 - S.N.Sivanandam, S.Sumathi, S.N.Deepa, TMH, 2006.
2. Introduction to Fuzzy Logic using MATLAB - S.N.Sivanandam, S.Sumathi, S.N.Deepa, TMH, 2006.
3. Neural Networks – Laurene Fausett.
4. Neural Engineering by C.Eliasmith and CH.Anderson, PHI
5. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications

Course Code	ENERGY AUDIT CONSERVATION AND MANAGEMENT	L	T	P	Credits
1002173210		3	1	0	3

Course Overview:

This is an open elective course developed to meet the current needs of the industry. This course covers topics such as energy conservation act and energy conservation. It also covers energy efficient lighting design. The student will learn power factor improvement techniques, energy efficiency in HVAC systems. In addition The economic aspects such as payback period calculations, life cycle costing analysis is covered in this course.

Course Objectives:

To introduce basic principles of energy auditing and to know about energy management. Also it provides immense knowledge about energy efficient motors, power factor improvement, lighting and energy instruments. Finally economic aspects are analyzed.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Apply principles of energy auditing and propose energy conservation schemes	Apply (3)	1, 2, 3, 8
CO2	Demonstrate principle and organizing energy management program	Demonstrate (4)	1, 2
CO3	Analyze power factor improvement methods, and Demonstrate the operating principle of energy efficient motors	Analyze (4)	1, 2, 3
CO4	to analyse about space heating and ventilation methods and demonstrate the operation of various energy instruments	Analyze (4)	1, 2, 8
CO5	Analyze and compute the economic aspects of energy consumption	Analyze (4)	1, 8

Unit-I:

Basic Principles of Energy Audit:

Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Piecharts –Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems.

Outcome: To be able to understand the basic energy audit principles and conservation

schemes

Activity/Event: To conduct basic energy auditing in a industry or organization.

Unit-II:

Principles of Energy Management:

Principles of energy management – Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions of energy manager –Language – Questionnaire – Check list for top management.

Outcome: Demonstrate principle and organizing energy management program.

Activity/Event: To write a basic report on energy management schemes

Unit-III:

Power Factor Improvement and Energy Efficient Motors:

Power factor – Methods of improvement – Location of capacitors – Power factor with non linear loads – Effect of harmonics on Power factor – Basic Numerical problems.Energy efficient motors , factors affecting efficiency, loss distribution, characteristics – variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit.

Outcome: Analyze power factor improvement methods, and Demonstrate the operating principle of energy efficient motors.

Activity/Event: To design a basic SIMULINK model on power factor improvement techniques

Unit-IV:

Space Heating, Ventilation and Energy Instruments:

Introduction – Heating of buildings – Transfer of Heat–Space heating methods Ventilation and air–conditioning –Insulation–Cooling load – Electric water heating systems Energy Instruments – Data loggers –Pyrometers– Tong testers – Power analyzer.

Outcome: To analyse about space heating and ventilation methods and demonstrate the operation of various energy instruments.

Activity/Event: Calibration of tongtestor to perform heat transfer methods

Unit-V:

Economic Aspects, Analysis & Computation:

Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method , replacement analysis, life cycle costing analysis. Need of investment, Calculation of simple payback period–Return on investment – Net present value – Internal rate of return – numerical examples

Outcome: Analyze and compute the economic aspects of energy consumption.

Activity/Event: To Compute the power bill of the department and propose energy efficient methods to reduce.

Text Books:

1. Energy Management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. Energy Efficient Electric Motors by John. C. Andres, Marcel Dekker Inc. Ltd – 2nd Edition, 1995

Reference Books:

1. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill Publishing Company Ltd, New Delhi.
2. Energy management hand book by W. C. Turner. John wiley and sons

Course Code		L	T	P	Credits
1002173221	ELECTRICAL MEASUREMENTS LAB	0	0	3	2

Course Overview:

Electrical and Electronic Instrumentation plays a key role in the industry. With the advancement of technology day to day manual maintenance is replaced by simply monitoring using various instruments. Thus this course plays very important role in overall maintenance of the industry.

Course Objectives:

1. To understand the correct function of electrical parameters and calibration of voltage, current, single phase and three phase power and energy, and measurement of electrical characteristics of resistance, inductance and capacitance of a circuits through appropriate methods.
2. To understand testing of transformer oil.
3. To understand the measurements of displacement and strain

Course outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Measure the electrical parameters voltage, current, power, energy, displacement, Strain	Evaluate (6)	1,2,3,4,6,7,8
CO2	Calibrate the Voltmeter, Ammeter, and Energy meter.	Analyze (4)	1,2,3,4,6,7,8
CO3	Determine electrical characteristics of resistance, inductance and capacitance.	Analyze (4)	1,2,3,4,6,7,8
CO4	Test transformer oil for its effectiveness.	Analyze (4)	1,2,3,4,6,7,8

Any 10 of the following experiments are to be conducted:

1. Calibration and Testing of single phase energy Meter
2. Calibration of dynamometer wattmeter using direct loading
3. Calibration of PMMC ammeter and voltmeter using Crompton D.C. Potentiometer
4. Measurement of resistance and Determination of Tolerance using Kelvin's double Bridge.
5. Capacitance Measurement using Schering bridge.
6. Inductance Measurement using Anderson bridge.
7. Measurement of 3 phase reactive power with single phase wattmeter for balanced loading.
8. Calibration of LPF wattmeter by phantom loading.

9. Measurement of 3 phase power with single watt meter and using two C.Ts.
10. C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given C.T. by Null method.
11. Dielectric oil testing using H.T test Kit.
12. Measurement of Power by 3 Voltmeter and 3 Ammeter method.
13. LVDT – characteristics and Calibration
14. Resistance strain gauge – strain measurements and Calibration

Course Code	MICROPROCESSORS AND	L	T	P	Credits
1002173222	MICROCONTROLLERS LAB	0	0	3	2

Learning Objectives:

- To study programming based on 8086 microprocessor and 8051 microcontroller.
- To study 8086 microprocessor based ALP using arithmetic, logical and shift operations.
- To study to interface 8086 with I/O and other devices.
- To study parallel and serial communication using 8051 micro controllers.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Will be able to write assembly language program using 8086 micro based on arithmetic, logical, and shift operations	Evaluate (6)	3, 4, 11, 12
CO2	Will be able to interface 8086 with I/O and other devices.	Analyze (4)	3, 5
CO3	Will be able to do parallel and serial communication using 8051 microcontrollers	Analyze (4)	3, 9, 11, 12

Any 10 of the following experiments are to be conducted:

Part A

Microprocessor 8086

1. **Arithmetic operation** – Multi byte addition and subtraction, multiplication and division, ASCII – Arithmetic operation.
2. **Number system conversions** –BCD to ASCII conversion, hexadecimal to decimal conversion.
3. **String operations:** Move block, Reverse string, Inserting, Deleting, Length of the string, String comparison, Sorting.

Microcontroller 8051

4. Timer in different modes using 8051
5. Serial communication implementation using 8051
6. Reading and Writing on a parallel port using 8051
7. Finding number of 1's and number of 0's in a given 8-bit number
8. Addition of even numbers from a given array

Part-B

Interfacing of I/O Devices

9. Generation of waveforms by Interfacing 8255–PPI to 8086 & 8051.
10. Interfacing 8259 – Interrupt Controller to 8086 & 8051.
11. Interfacing 8279 – Keyboard Display to 8086 & 8051.
12. Stepper motor control using 8086 & 8051.
13. Interfacing of Traffic signal lights to the 8086.

Course code		L	T	P	Credits
1099172103	PROFESSIONAL ETHICS AND HUMAN VALUES	2	0	0	0

Course Overview:

Professional Ethics and Human Values subject provides character oriented education that instills basic values and ethnic value in one's individual professionalism.

Course Objectives:

1. To encourages students to discover what they consider valuable.
2. To move from discrimination to commitment. It is to create an ability to act on any discrimination in a given situation.
3. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
4. To appreciate the rights of others.
5. Making the students aware and sensitive to value system in real life situations. To help the students to discriminate between ephemeral and eternal values.

Course Outcomes:

	Course Outcome	Cognitive level as per Bloom's Taxonomy	PO
CO1	Recognize importance of human values, harmony and ethical behavior in real life situations	Understanding	8
CO2	Describe the core values that shape the ethical behaviour of an engineer	Understanding	8
CO3	Recall basics of professional ethics and human values.	Remembering	8
CO4	Listing sustained happiness through identifying the essentials of human values and skills.	Remembering	8
CO5	Describe the practical importance of trust, mutually satisfying human behaviour and enriching interaction with nature	Understanding	8

Unit-I:

Human Values :

Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully -Caring – Sharing – Honesty –Courage – Value time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality-Character

Outcome: Seminar

- To understand different types of human values
- To Identify values linked to the ethical behavior

Activity/Event : Seminar

Unit-II:

Engineering Ethics:

The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics-Consensus and Controversy – Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Types of Inquiry – Engineering and Ethics- Kohlberg's Theory – Gilligan's Argument – Heinz's Dilemma

Outcome:

- To enable understanding on engineering ethics
- To enable knowledge on professional level ethical theories

Activity/Event: Seminar

Unit-III:

Engineering as Social Experimentation:

Comparison with Standard Experiments – Knowledge gained –Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering.

Outcome: Seminar

- To Understandtheapplicationof ethics in social experimentation
- To gain knowledge onaengineers as different roles

Activity/Event: Case Analysis

Unit-IV:

Engineers' Responsibility for Safety and Risk:

Safety and Risk, Concept of Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

Outcome: Seminar

- To understand the challenge for engineers to create safety to risk
- To enable the knowledge on the risk bearable level

Activity/Event: Seminar

Unit-V:

Engineers' Responsibilities and Rights:

Collegiality-Loyalty-Professionalism and Loyalty- Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-Ethical egoism-Collective bargaining-Confidentiality-Acceptance of Bribes/Gifts- when is a Gift and a Bribe-examples of Gifts v/s Bribes-problem solving-interests in other companies-Occupational Crimes-industrial espionage-price fixing-endangering lives- Whistle Blowing-types of whistle blowing-when should it be attempted-preventing whistle blowing. Cross-culture Issues.

Outcome: Seminar

- To enable understanding on engineers responsibilities
- To enable knowledge on different types of rights of engineers

Activity/Event : Seminar

Text Books:

1. M"Engineering Ethics and Human Values" by M.Govindarajan, S.Natarajan and V.S.Senthil Kumar- PHI Learning Pvt. Ltd-2009
2. "Professional Ethics and Morals" by Prof.A.R.Aryasri, DharanikotaSuyodhana-Maruthi Publications
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran- Laxmi Publications
4. "Professional Ethics and Human Values" by Prof.D.R.Kiran

Reference Books:

1. "Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication
2. "EthicsinEngineering"byMikeW.MartinandRolandSchinzinger–TataMcGraw-Hill–2003.
3. "Engineering Ethics" by Harris, Pritchardand Rabins, CENGAGE Learning, India Edition, 2009.

Course Code		L	T	P	Credits
1002173241	INDUSTRY ORIENTED MINI PROJECT	0	0	3	2

Industry- Oriented Mini Project: The Industry oriented mini project is carried out during the third year second semester vacation. The students have an option to choose their own area of interest which may be related to the course work. Mini project report is evaluated for 100 marks in fourth year first semester before the first mid-term exam. Assessment is done by the supervisor /guide for 40 marks based on the work and mini project report. The remaining 60 marks are allocated for presentation by the student to a committee comprising of the project supervisor and two senior faculty members nominated by Head of the Department.

PROGRAM STUCTURE

FOR

IV B.TECH

I &II SEMESTERS

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
PROGRAM STRUCTURE

IV B.Tech I-Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1002174101	Utilization of Electrical Energy	3	1	0	3
2	1002174102	Programmable Logic Controller	3	1	0	3
3	1002174103	Power System Operation & Control	3	1	0	3
4	1002174104	Switchgear and Protection	3	1	0	3
5	**Elective – II:**					
	1002174105	4. Distributed Generation and Micro Grids	3	1	0	3
	1002174106	5. Advanced Control Systems				
	1004174105	6. IoT & its Applications				
6	**Open Elective-II:** /MOOCs					
	1005172104	5. Java Programming	3	1	0	3
	1005172201	6. Data Base Management Systems				
	1004173203	7. VLSI Design				
	1099173201	8. Entrepreneurship Development				
7	1002174121	Electrical Simulation Lab	0	0	3	2
8	1002174122	Power Systems & Simulation Lab	0	0	3	2
9	1099173101	IPR & Patents	2	0	0	0
		Total Credits :				**22**

IV B.Tech II- Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1002174201	Digital Control Systems	3	1	0	3
2	1002174202	HVDC Transmission	3	1	0	3
3	1002174203	Electrical Distribution Systems	3	1	0	3
4	**Elective – III:**					
	1002174204	5. Smart Grid Technologies	3	1	0	3
	1002174205	6. Flexible Alternating Current Transmission Systems				
	1002174206	7. Power System Reforms				
	1002174207	8. Condition Monitoring of Electrical Equipments				
		(or)				
1002174281		Internship	0	0	0	12
5	1002174251	Technical Seminar	0	3	0	2
6	1002174261	Comprehensive Viva	0	0	0	2
7	1002174231	Main Project	0	0	0	10
		Total Credits :				**26**

Course Code		L	T	P	Credits
1002174101	UTILIZATION OF ELECTRICAL ENERGY	3	1	0	3

Learning Objectives:

- To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading conditions.
- To acquaint with the different types of heating and welding techniques.
- To study the basic principles of illumination and its measurement and understand different types of lightning system including design.
- To understand the basic principle of electric traction including speed–time curves of different traction services.
- To understand the method of calculation of various traction system for braking, Acceleration and other related parameters.

Course Outcomes

After completing this Course, the student should be able to:

1. Identify a suitable motor for electric drives and industrial applications
2. Describe various electrical heating, welding methods.
3. Explain the basic terminology in illumination and compare the type of lamps
4. Analyze the speed –time characteristics of different services of traction and calculate tractive effort, power and specific energy.

UNIT – I:

Selection of Motors

Choice of motor, type of electric drives, starting and running characteristics–Speed control–Temperature rise–Applications of electric drives–Types of industrial loads–continuous–Intermittent and variable loads–Load equalization, ingress protection for electric motors.

UNIT – II:

Electric Heating

Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating – Arc furnaces – Direct and indirect arc furnaces

Electric Welding

Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding

UNIT – III:

Illumination Fundamentals & Various Illumination Methods:

Illumination Fundamentals

Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Discharge lamps, MV and SV lamps – Lumen or flux method of calculation - Sources of light.

Various Illumination Methods:

Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting, principle of operation, street lighting and domestic lighting – Conservation of energy.

UNIT– IV:

Electric Traction – I

System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor,basic principle ofMagnetic levitation trains – Mechanics of train movement–Speed– time curves for different services – Trapezoidal and quadrilateral speed time curves-High speed transportation trains.

UNIT – V:

Electric Traction – II

Calculations of tractive effort– power –Specific energy consumption for given run–Effect of varying acceleration and braking retardation–Adhesive weight and braking, retardation adhesive weight and coefficient of adhesion–Principles of energy efficient motors-Modern traction motors.

Text Books:

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai& Sons.

Reference Books:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997.

Course Code	PROGAMMABLE LOGIC CONTROLLER	L	T	P	Credits
1002174102		3	1	0	3

Course Overview: In most of the industry applications, computer control is gaining importance, PLC is an industry computer, hence this course PLC makes the students to acquire knowledge required for industry.

Course Objectives:

- To have knowledge on PLC.
- To acquire the knowledge on programming of PLC.
- To understand different PLC registers and their description.
- To have knowledge on data handling functions of PLC.
- To know how to handle Hardware configuration and develop logic for different Industrial Applications.

Course Outcomes: After completion of the course, students are able to:

- Understand the PLCs and their I/O modules.
- Develop control algorithms to PLC using ladder logic.
- Manage PLC registers for effective utilization in different applications.
- Design Hardware configuration and develop logic for different Industrial Applications.

Unit-I: PLC Basics

PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

Unit-I Outcome: Understand the PLCs and their I/O modules

Activity/Event on Unit-1: Note specifications of different industrial I/O Devices.

Unit-II: PLC Programming

PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams and sequence listings, ladder diagram construction.

Unit-II Outcome: Able to Develop control algorithms to PLC using ladder logic.

Activity/Event on Unit-II: Develop ladder diagram for simple DC motor control by taking to two input sensor signals.

Unit-III: Programmable Timers and Counters

Timer instructions – On delay timer instruction – Off delay timer instruction – Retentive timer – Counter instructions – Up counter – Down counter - Cascading counters – Incremental encoder – Counter applications – Combining counter and timer functions.

Unit-III Outcome: able to write ladder logic for timer and counter functions to PLC**.**

Activity/Event on Unit-III: Develop a ladder logic for On-Off control of DC motor with some delay by taking input signals from the sensor**.**

Unit-IV: Program Control and Other Instructions

Master control reset instruction – Jump instructions and sub routines – Immediate input and

output instructions.
Data manipulation – Data transfer operation – Data compare instruction – Data manipulation programs – Numerical data I/O interfaces – Math instructions – Addition, subtraction, multiplication & division instruction – Sequential instructions – Sequence programs – Shift registers – Word shift registers.

Unit-IV Outcome: Manage PLC registers for effective utilization in different applications

Activity/Event on Unit-IV: Develop logic for any application based on any one of the math instruction.

Unit-V: Applications

Control of water level indicator – Alarm monitor - Conveyor motor control – Parking garage– Ladder diagram for process control – PID controller.

Unit-V Outcome: able to write and develop logic for any industrial control application.

Activity/Event on Unit-V: Develop a photo type model of conveyor motor control using PLC.

Text Books:

1. Programmable logic controllers by Frank D.Petruzella- McGraw Hill – 3rd Edition.
2. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI

Reference Books:

1. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.
2. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning.
3. Programmable Logic Controllers –W.Bolton-Elsevier publisher

Course Code	POWER SYSTEM OPERATION & CONTROL	L	T	P	Credits
1002174103		3	1	0	3

Pre-requisites:
Power Generation Engineering& Economics, Power Transmission Engineering.

Learning Objectives:
- To examine the operation of various components in control of power system.
- To determine optimal scheduling of Hydrothermal Systems and to solve unit commitment problem.
- To analyse single area and two area load frequency control.
- To investigate reactive power control problem in transmission systems.

Course Outcomes:
After completion of the course, the student will be able:
- To analyse the operation of various components in control of power system.
- To solve optimal scheduling of Hydrothermal Systems and unit commitment problem, using various algorithms
- To inspect single area and two area load frequency control.
- To regulate reactive power in transmission systems.

UNIT–I: INTRODUCTION
Operating States of Power System, Objectives of Control, Key Concepts of Reliable Operation, Preventive and Emergency Controls.

ADVANCED CONTROL OF POWER SYSTEMS
Need for computer control of power systems – concept of energy control centre (Load Dispatch Centre in India) – functions – system monitoring – data acquisition and control – system hardware configuration – SCADA and EMS functions. Introduction to PMU.

UNIT II: ECONOMIC OPERATION OF POWER SYSTEMS
Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve – coordination equations without and with loss (No derivation of loss coefficients) – solution by direct method and λ-iteration method. Optimal scheduling of Hydrothermal System-Problems.

UNIT–III: UNIT COMMITMENT
Optimal unit commitment problem – Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming-Deviation Settlement Mechanism(DSM).

UNIT IV: P-F CONTROL
Basics of speed governing mechanism and modelling – speed-load characteristics – load sharing between two synchronous machines in parallel – control area concept – LFC control of a single-area system – static and dynamic analysis of uncontrolled and controlled cases – two-area system – modelling – static analysis of uncontrolled case – tie line with frequency bias control.

UNIT V: Q-V CONTROL

Overview of Reactive Power control – Reactive Power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation – Specifications of load compensator – Uncompensated and compensated transmission lines: Shunt and series compensation – Need for FACTS controllers.

TEXT BOOKS:

1. D.P.Kothari and I.J.Nagrath, "Modern Power SystemAnalysis", Tata Mc-Graw Hill Publishing Company, 3rdEdition, 2008.

REFERENCES:

1. C.L.Wadhwa, "Electrical Power Systems", New AgeInternational Publishers, 6thEdition, 2009.
2. O. I. Elgerd, "Electric Energy Systems Theory", Tata McGraw-Hill Publishing Company, Second Edition, 2007.
3. A. J. Wood and B.F.Wollenberg, "Power Generation,Operation and Control", John-Wiley & Sons, Second edition,2006.
4. T.J.E.Miller, "Reactive Power Control in Electric Systems",John Wiley & Co, 1982.
5. PrabhaKundur, "Power System Stability and Control",McGraw Hill Education, 2005.

Course Code		L	T	P	Credits
1002174104	SWITCHGEAR AND PROTECTION	3	1	0	3

Course Objectives:

- To provide the basic principles and operation of various types of circuit breakers.
- To study the classification, operation and application of different types of electromagnetic protective relays.
- To explain protective schemes, for generator and transformers and various protective schemes used for feeders and bus bars.
- To explain the principle and operation of different types of static relays.
- To study different types of over voltages in a power system and principles of different protective schemes for insulation co–ordination.

Course Outcomes:

After the completion of course, student will be able to

1. Explain the principles of Arc Interruption for application to high voltage circuit breakers of air, oil, vacuum and SF6 gas Circuit breakers
2. Describe the working principle and constructional features of different types of electromagnetic protective relays and static relays with a view to application in the system.
3. Illustrate various types of faults that occur in transformers, alternators, feeders and bus bars, and apply suitable protection schemes for different types of faults.
4. Summarize different type of over voltages appearing in a system including existing protective schemes required for insulation co-ordination.

UNIT–I: Circuit Breakers

Miniature Circuit Breaker (MCB), MPCB, ELCB, RCCB– Selection of MCB based on Curves, Elementary principles of arc interruption– Restriking Voltage and Recovery voltages– Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching– Introduction to oil circuit breakers– Description and operation of Air Blast– Vacuum and SF6 circuit breakers– CB ratings and specifications– Concept of Auto reclosing.

UNIT–II: Electromagnetic Protection

Relay connection – Balanced beam type attracted armature relay - induction disc and induction cup relays–Torque equation - Relays classification–Instantaneous– DMT and IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

UNIT–III: Generator Protection

Protection of generators against stator faults, Differential Protection for generator– Rotor faults and abnormal conditions–restricted earth fault and inter turn fault protection– Numerical examples.

Transformer Protection

Protection of transformers: Percentage differential protection– Design of CT's ratio– Buchholz relay protection–Numerical examples.

Feeder and Bus bar Protection

Protection of lines: Over current Protection schemes – PSM, TMS - Numerical examples - Carrier current and three zone distance relay using impedance relays–Protection of bus bars by using Differential protection.

UNIT–IV: Static and Digital Relays

Static relays: Static relay components– Static over current relays– Static distance relay– Micro processor based digital relays, Numerical Relays (Basic Operation Only).

UNIT–V: **Grounding and Protection against over voltages**

Grounded and ungrounded neutral systems–Effects of ungrounded neutral on system performance– Methods of neutral grounding: Solid–resistance–Reactance–Arcing grounds and grounding Practices.

Generation of over voltages in power systems– Protection against lightning over voltages and Switching over voltages– Valve type and zinc oxide lightning arresters– Insulation coordination– BIL– impulse ratio– Standard impulse test wave– volt-time characteristics.

Text Books:

1. Power System Protection and Switchgear by Badari Ram and D.N Viswakarma, TMH Publications
2. Power system protection- Static Relays with microprocessor applications. by T.S.MadhavaRao, TMH

Reference Books:

1. Fundamentals of Power System Protection by Paithankar and S.R.Bhide.,PHI, 2003.
2. Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.
3. Protection and SwitchGear by BhaveshBhalja, R.P. Maheshwari, NileshG.Chothani, Oxford University Press, 2013

Course Code	DISTRIBUTED GENERATION AND MICROGRIDS	L	T	P	Credits
1002174105		3	1	0	3

Course Overview:
To impart knowledge about distributed generation technologies, their interconnection in grid, to understand relevance of power electronics in DG, to understand concept of microgrid.

Course Objectives:
The objective of the course is

- To understand distributed generation concepts and interconnection issues of DGs
- To understand operation of various types of DG systems
- To study power electronics application to DG systems
- To study and understand operation and control of Microgrids
- To understand reliability and market issues of microgrids

Course Outcomes:

At the end of the course, the student will be able to

- To explain topologies and interconnection issues of DGs
- To explain features of grid connected DG systems
- To design power converter topologies for DG applications
- To implement the control of MG and understand market issues of Microgrid

Unit-I: INTERCONNECTION ISSUES AND STANDARDS OF DGs

Concept of distributed generations (DG) or distributed energy resources (DERs), topologies, selection of source, dependence on storage facilities, regulatory standards/ framework, standards for interconnecting DGs to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Grid code and Islanding & non-islanding system

Unit-II: OPERATIONAL FEATURES OF GRID CONNECTED DG SYTEMS

Grid interconnection issues for grid connected operation of various types of DG systems. Constraints on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Reliability, stability and power quality issues involved in grid connected operation of various DGs.

Unit-III: POWER ELECTRONICS AND DG SYSTEMS

Relevance of power electronics in DG applications, Power quality requirements and source switching using SCR based static switches, Distribution system loading, line drop model, series voltage regulators and on line tap changers, power converter topologies, model and specifications for DG applications, issues filter designs, harmonic reduction, Control of DG inverters, phase

locked loops, current control and DC voltage control for standalone and grid parallel operations. Protection of converters, power quality implication

Unit-IV: OPERATION, CONTROL AND MODELLING OF MICROGRID

Concept and definition of microgrid, review of sources of microgrids, typical structure and configuration of a microgrid, microgrid implementation in Indian and international scenario, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode operation, anti-islanding schemes. Control techniques for voltage, frequency, active and reactive power control of microgrid system

Unit-V: INTRODUCTION TO RELIABILITY AND MARKET ISSUES OF MICROGRID

Power quality issue, THD reduction techniques, protection and stability analysis of microgrid, regulatory standards, introduction to microgrid reliability. Features of microgrid economy and market. LVDC Microgrid.

Text Books:

1. Renewable Energy- Power for a sustainable future, third edition, Edited by Godfrey Boyle,Oxford University Press, 2013.
2. AmirnaserYezdani, and Reza Iravani, "Voltage Source Converters in Power Systems:Modeling, Control and Applications", IEEE John Wiley Publications, 2009.
3. DorinNeacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor& Francis, 2006. New Delhi.
4. Microgrids: Architectures and Control, Nikos Hatziargyriou (Editor), ISBN: 978-1-118-72068-4, 340 pages, December 2013, Wiley-IEEE Press
5. Microgrids and Active Distribution Networks, S. Chowdhury, S.P. Chowdhury and P.Crossley, The Institution of Engineering and Technology, London, U.K, 2009.

Course Code	ADVANCED CONTROL SYSTEMS	L	T	P	Credits
1002174106		3	1	0	3

Course Overview:

This Course aims to study state space, nonlinear systems, describing function approach, phase plane and Lyapunov stability analysis. It also deals with modern control and optimal control systems.

Course Objectives:

1. Review the state space representation of a control system
2. understand the State feedback controller and State observer
3. Analyze nonlinear system using Describing function approach and Phase plane analysis, and Lypanov's method of stability analysis of a system.
4. Formulation of Euler Lagrange equation for the optimization of typical functional and solutions.
5. Formulation of linear quadratic optimal regulator problem and its design.

Course Outcomes:

At the end of the course, students will be able to

1. Understand the State space representation and nonlinear systems.
2. Understand the application of calculus of variations to optimal control problems
3. Determine the state feedback gains with & without observer
4. Design optimal Linear Quadratic regulator

UNIT I: State space analysis:

General State Space Representation, Canonical forms – Controllable canonical form – Observable canonical form, and Jordan Canonical Form. Solution of state equation, State transition matrix (no derivations and problems) –

UNIT II: Design of State Feedback controller &Observer :

Tests for controllability and Observability for continuous time systems – Time invariant case – Principle of duality -controllability and observability from Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability – Design of state feedback control through pole placement. state observers-Design of full order state observer

UNIT III: Non-linear systems

Introduction to non-linear systems, Types of non-linearities, describing functions, Introduction to phase–plane analysis.

Stability in the sense of Lyapunov – Lyapunov stability and Lypanov's instability theorems – Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.

UNIT IV: Introduction to optimal control - Calculus of variations:

Optimal control problem formulation- Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints – Euler-Lagrange equation.

UNIT V: Optimal control of LTI systems:

Linear Quadratic Optimal Regulator (LQR) problem formulation – Optimal regulator design by parameter adjustment (Lyapunov method) – Optimal regulator design by Continuous Time Algebraic Ricatti equation (CARE) - Optimal controller design using LQG framework.

Text Books:

1. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication
2. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd Edition,1996
3. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.

Reference Books:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998
2. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
3. Optimal control systems by D S Naidu, CRC publications.

Course Code		L	T	P	Credits
1004174105	IOT & ITS APPLICATIONS	3	1	0	3

Course Overview: The purpose of this course is to impart knowledge on IoT Technology and Architecture, Internal communication protocols, corrections with other technologies, real time applications ad study practical design and implementation issues

Course Objectives:
The main objective of course make student to understand the IoT basic concepts, standards, communication protocols, technological relation and real time applications and their design, implementation and deployment issues.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	To Understand the Architecture, protocols and applications of IoT.	Understand	PO1
CO2	To Analyse the communication protocols and standards used in IoT	Analyse	PO2
CO3	To analyse and design the simple IoT applications to monitor or control IoT devices using simulation or hardware	Design and Creative thinking	PO3,PO6,PO7
CO4	To implement the real time IoT applications.	Design and Deployment	PO4,PO5,PO11, PO12

Unit-I: Introduction to IoT, Need of Internet of Things, Internet of Things ERA, Characteristics of Internet of Things, architectural view of Internet of Things, Technologies behind Internet of Things – Server- End Technology – Major Components of IoT system – Development Tools – API and device interfacing components, Sources of IoT, Examples of IoT – Smart Watch – Smart Home – Smart Phone.

Unit-I Outcome: Understand the characteristics, physical and logical of IoT and their application.
Activity/Event on Unit-1: Identify physical and logical components involved in IoT applications

Unit-II: Introduction, Generic computing systems Vs. Embedded systems, Purpose of Embedded Systems - Typical Embedded System – Core of the Embedded System – Memory – Sensors and Actuators with I/O subsystems – Communication Interfaces – Wireless Interfaces and Wire Interfaces – Characteristics of Embedded Systems – Quality Attributes of an Embedded Systems.

Unit-II Outcome: Analyze and design hardware and software components of IoT application

Activity/Event on Unit-2: Identification day to day embedded devices along with hardware and software components

Unit-III:M2M communication – M2M to IoT – M2M architecture – software development tools, Communication Technologies – Wireless communication technologies – Wired Communication, Physical Design of IoT – Things in IoT – IoT Protocols, Logical design of IoT – IoT functional blocks – IoT communication models.

Unit-III Outcome: Analyze and design the communication protocols of IoT applications

Activity/Event on Unit-3: Identification of communication styles of various IoT Protocols

Unit-IV: Basic building blocks of an IoT devices, Introduction about the Raspberry Pi Board, Operating systems for Raspberry Pi, Interfaces for IoT – Serial Interface – SPI – I2C, IoT Design Methodology – Requirements – Process – Domain Model – Information model – service – Functional View – Operational View – Device & components Integration – Application development.

Unit-IV Outcome: Construction of IoT systems with raspberry pi and simulation tools

Activity/Event on Unit-4: Hands-on setup of IoT Systems using Raspberry pi

Unit-V: Case Studies: Home Automation – Smart lighting – Home intrusion detection, Cities – smart parking, Environment – Weather monitoring system – Air Pollution Monitoring – Forest Fire Detection, Agriculture – smart irrigation system.

Unit-V Outcome: Understand physical and logical aspects of real time IoT applications.

Activity/Event on Unit-5: Mini project on IoT applications for monitoring/control devices

Text Books:

01. Internet of Things: A hands-On Approach, Arshdeep Bahga, Vijay Madisetti, 2014 edition, University Press.
02. The Internet of Things: Enabling technologies, Platforms and Use cases, Pethuru Raj and Anupama C. Raman, 2017 edition, CRC Press, Taylor and Francis Group.
03. Introduction to Embedded Systems, Shibu K V, 2nd Edition, Tata Mc-Graw hill Edition.

1. Reference Books:

01. Internet of Things: Architecture and design Principles, Raj Kamal, Tata Mc-Graw hill Edition.
02. Embedded Systems: Architecture and applications, Raj Kamal, Tata Mc-Graw hill Edition.

Course Code	ELECTRICAL SIMULATION LAB	L	T	P	Credits
1002174121		0	0	3	2

Course objectives:

- To simulate integrator circuit, differentiator circuit, Boost converter, Buck converter, full convertor and PWM inverter.
- To simulate transmission line by incorporating line, load and transformer models.
- To perform transient analysis of RLC circuit and single machine connected to infinite bus(SMIB).

Following experiments are to be conducted:

1. Simulation of transient response of RLC circuits
    a. Response to pulse input
    b. Response to step input
    c. Response to sinusoidal input
2. Analysis of three phase circuit representing the generator transmission line and load. Plot three phase currents & neutral current.
3. Simulation of single–phase full converter using RLE loads and single phase AC voltage controller using RL loads
4. Plotting of Bode plots, root locus and Nyquist plots for the transfer functions of systems up to 5th order
5. Simulation of Boost and Buck converters.
6. Integrator & Differentiator circuits using op–amp.
7. Simulation of D.C separately excited motor using transfer function approach.

Any 2 of the following experiments are to be conducted:

1. Modeling of transformer and simulation of lossy transmission line.
2. Simulation of single phase inverter with PWM control.
3. Simulation of three phase full converter using MOSFET and IGBTs.
4. Transient analysis of single machine connected to infinite bus(SMIB).

Course outcomes:

- Able to simulate integrator circuit, differentiator circuit, Boost converter, Buck
- converter, full convertor and PWM inverter.
- Able to simulate transmission line by incorporating line, load and transformer models.
- Able to perform transient analysis of RLC circuit and single machine connected to infinite bus(SMIB).

Reference Books:

1. "Simulation of Power Electronic Circuit",by M.B.patil, V.Ramanarayan, V.T.Ranganathan.Narosha,2009.
2. Pspice for circuits and electronics using PSPICE – by M.H.Rashid, M/s PHI Publications
3. Pspice A/D user`s manual – Microsim, USA
4. Pspice reference guide – Microsim, USA
5. MATLAB user`s manual – Mathworks, USA
6. MATLAB – control system tool box – Mathworks, USA
7. SIMULINK user`s manual – Mathworks, USA
8. EMTP User`s Manual.

Course Code		L	T	P	Credits
1099173101	IPR & PATENTS	2	0	0	0

Course Objectives:

To know the importance of Intellectual property rights, which plays a vital role in advanced Technical and Scientific disciplines.
Imparting IPR protections and regulations for further advancement, so that the students can familiarize with the latest developments.

Course Outcomes:
IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents.
Studentget an insight on Copyrights, Patents and Software patents which are instrumental for further advancements.

Unit-I: Introduction to Intellectual Property Rights (IPR)
Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

Unit-II: Copyrights and Neighboring Rights
Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers **–** Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act

Unit-III: Patents
Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations.

Trademarks
Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities

- Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

Unit-IV: Trade Secrets

Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets - Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law.

Unit-V: Cyber Law and Cyber Crime

Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions - E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers.

Relevant Cases Shall be dealt where ever necessary.

Reference Books:

- Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
- Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.
- Prabhuddha Ganguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
- Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
- Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).
- Cyber Law - Texts & Cases, South-Western's Special Topics Collections
- R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.
- M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

Course Code		L	T	P	Credits
1002174122	POWER SYSTEMS & SIMULATION LAB	0	0	3	0

Course Overview:

To impart the practical knowledge of functioning of various power system components and determination of various parameters and simulation of load flows, transient stability, LFC and Economic dispatch.

Course Objectives:

1. To impart hands on experience and to calculate the fault current and fault impedance for alternator and transformer.
2. To understand the basic tools used in MATLAB/SIMULINK

Course Outcomes:

After completion of Power Systems Lab the students will be able to

1. Analyze the fault current and sequence impedance of 3-phase alternator and transformer
2. Compare the settling time and steady state error for LFC with and without controller.
3. Perform load flow analysis for a N-bus system using GS & NR method
4. Calculate the economical load dispatch for optimum operation of generators & to Determine the A,B,C,D parameters for a long ,medium, short transmission line.

Any 10 of the following experiments are to be conducted

1. Sequence impedances of 3 phase Transformer
2. Sequence impedances of 3 phase Alternator by Fault Analysis.
3. Sequence impedances of 3 phase Alternator by Direct method.
4. ABCD parameters of long medium and short Transmission line.
5. Calibration of Tong Tester.
6. Load flow studies using Gauss-seidel method.
7. Load flow studies using N-R method.
8. Load frequency control with controller.
9. Load frequency control without controller.
10. Economic load dispatch without losses.
11. Economic load dispatch with losses.
12. Power angle characteristics of a 3 phase alternator with infinite bus bar.

Course Code		L	T	P	Credits
1005172201	DATABASE MANAGEMENT SYSTEMS	3	1	0	3

Course Overview:

This course introduces database design and creation using a DBMS product. Emphasis is on data dictionaries, normalization, data integrity, data modelling, and creation of simple tables, queries, reports, and forms. Upon completion, students should be able to design and implement normalized database structures by creating simple database tables, queries, reports, and forms.

Course Objectives:

- Provide students with theoretical knowledge and practical skills in the use of database and database management systems in information technology applications.
- The logical design, physical design and implementation of relational databases are covered.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe ER model and normalization for database design.	Analyzing	PO1, PO2, PO4
CO2	Create, maintain and manipulate a relational database using SQL	Applying	PO1,PO2,PO4,PO5
CO3	Design and build database system for a given real world problem	Applying	PO1,PO2,PO4,PO5
CO4	Examine issues in data storage and query processing and can formulate appropriate solutions.	Understand	PO1, PO2

Unit-I:

Introduction to Database Systems, :

File System Vs DBMS, Advantages of DBMS, Structure of DBMS, Levels of Data Abstraction (Data Independence), Database Users and Administrators, Different Data Models.

E-R Model:

Overview of Database Design, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model.

Outcome:

After Completion of the Unit, Student will Be able to:

1. Describe the Architecture of Database Management Systems
2. Design different ER Models
3. Understand the applications of dbms, difference between file systems vs dbms, identify the data models ,understand dbms structure

Activity:

Draw ER Diagram for Various Real Time Systems.

Unit-II:
Relational model:

Introduction to the Relational Model, Relational model constraints over relations. Relational Algebra and calculus

Outcome:

After Completion of the Unit, Student will Be able to:

1. To differentiate the knowledge in TRC & DRC
2. Compare relational model with the structured query language (SQL)
3. Understands the relational algebra concepts, selection ,projection ,relational calculus which helps in understanding queries

Activity:

Tabulate Various Relational Models for Real Time Application.

Unit-III:

SQL Queries:

The Form of Basic SQL Query, Union, Intersect and Except-Nested Queries-Aggregative Operators- Group By and Having Clauses-Null Values-Outer Joins.

Schema Refinement (Normalization):

Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form (BCNF), Lossless join and dependency preserving decomposition, Fourth normal form (4NF), De-normalization

Outcome:
After Completion of the Unit, Student will Be able to:

1. Design the new database.
2. Master the basic concepts and appreciate the applications of database systems.
3. Master the basics of SQL and construct queries using SQL.

Activity: Design a new Database and normalize the data.

Unit-IV:

Overview of Storage and Indexing:

Data on External Storage – File

Organization and Indexing – Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing.

Outcome:

After Completion of the Unit, Student will Be able to:

1. Differentiate different indexing techniques in real time.
2. An ability to use and apply current technical concepts and practices in the core information technologies.
3. Be familiar with a commercial relational database system (Oracle) bywriting SQL using the system.
4. Be familiar with the relational database theory, and be able to write relational algebra expressions for queries

Activity: Create your own data base and connect the front-End and back-End.

Unit-V:

Query processing, Transaction Management, Concurrency Control and Crash recovery Transactions: Acid Properties of Transaction - Transaction States - Schedule: Serial Schedule Concurrent Schedules - Anomalies Associated With Concurrent Schedules (RW, WR - and WW Conflicts) -Serializability – Conflict Serializability - and View Serializability. Introduction to Lock Management-Lock Based Concurrency Control: 2pl-Strict 2pl Concurrency without Locking, Timestamp–Based Concurrency Control – Optimistic Concurrency Control. Introduction to ARIES - The Log - The Write-Ahead Log Protocol Check Pointing

Outcome:

After Completion of the Unit, Student will Be able to:

1. Make us of transactions for new concepts.
2. Understands the properties of transaction management.
3. Master the basics of query evaluation techniques and query optimization.
4. Be familiar with the basic issues of transaction processing and concurrency control

Activity:

Perform Transaction on Various Real Time Concepts.

Text Books:

1. Database Management Systems, 3/e Raghuram Krishnan, Johannes Gehrke, TMH
2. Database System Concepts. 6/e Silberschatz, Korth, TMH
3. Database Management System, 6/e RamezElmasri, Shamkant B. Navathe, PEA

Reference Books:

1. Introduction to Database Systems, 8/e C J Date, PEA
2. The Database book principles & practice using Oracle/MySql NarainGehani, University Press.
3. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

Course code	JAVA PROGRAMMING	L	T	P	Credits
1005172104		3	1	0	3

Course Overview:

- Java has emerged as the object-oriented programming language of choice.
- Some of the important concepts of Java include are:
  1) A Java virtual machine (JVM), which provides the fundamental basis for platform independence
  2) Automated storage management techniques, such as garbage collection, collection frameworks
  3) Language syntax that is similar to that of the C language.

Course Objectives:

- To Understanding the object oriented programming concepts like Data Abstraction,
  Encapsulation, Inheritance and Polymorphism.
- Gain the knowledge about the relationship between the classes and objects.
- Understand the principles of Inheritance, Packages, Multithreading and Interfaces.
- To understand and apply the concepts of Applets and AWT.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Identify the concepts and features of object oriented programming in Java.	Understanding	PO1, PO2
CO2	Describe and implement the programs with command line arguments and Scanner Class.	Analyzing	PO1, PO2, PO3,PO5
CO3	Analyze and implement the concepts of Inheritances and Multithreading with real world scenario.	Applying	PO1, PO2, PO3,PO5
CO4	Develop GUI programs using Applets and Event Handling.	Applying	PO1, PO2, PO3,PO5

Unit-I:

Introduction to OOP, procedural programming language and object oriented language, principles of OOP, applications of OOP, history of java, java features, JVM, program structure.
Variables, primitive data types, identifiers, literals, operators, expressions, precedence rules and associativity, primitive type conversion and casting, flow of control.

Outcome:

After reading this Unit, student should be able to understand:

- Be familiar with Object oriented programming techniques.
- Explain the structure of the program
- Demonstrate various control structures in JAVA.

Activity: Simulate various control structures for real time applications.

Unit-II:

Abstract Data Type, Classes and objects, class declaration, creating objects, methods, constructors and constructor overloading, garbage collector, importance of static keyword and examples, this keyword, arrays, command line arguments, nested classes.

Outcome:

After reading this Unit, student should be able to understand:

- Outline the relation between class and object.
- Illustrate the difference between method and constructor overloading.
- Make use of static keyword and this keyword.
- Analyze the Command Line arguments.

Activity: Develop real time applications using OOPs concepts through various ADT's.

Unit-III:

Inheritance, types of inheritance, super keyword, final keyword, overriding and abstract class. Interfaces, creating the packages, using packages, importance of CLASSPATH and java. lang package. Exception handling, importance of try, catch, throw, throws and finally block, user defined exceptions, Assertions, Collection inbuilt classes.

Multithreading: introduction, thread life cycle, creation of threads, thread priorities, thread synchronization, communication between threads. Reading data from files and writing data to files.

Outcome:

After reading this Unit, student should be able to understand:

- Classify various types of Inheritance.
- Illustrate the difference between method overloading and overriding.
- Demonstrate to usage of Packages.
- Make use of Exception Handling.
- Develop and make use of synchronization through multithreading.

Activity: Develop enhanced applications from existing versions to new versions.

Unit-IV:

Applet class, Applet structure, Applet life cycle, sample Applet programs. Event handling: event delegation model, sources of event, Event Listeners.

Outcome:

After reading this Unit, student should be able to understand:

- Explain the structure of Applet Program.
- Construct an approach for event delegation model.
- Build the frame based applications using event handling mechanism.

Activity: Develop client browser applications with Graphics

Unit-V:

Java Swing package and AWT package: introduction, components and containers, JButton, Jlabel, JCheckbox, JRadio Button, JListJBoxes, JChoice Boxes, JContainer class, JLayouts,JMenu and JScrollbar.

Outcome:

After reading this Unit, student should be able to understand:

- Extend the importance of AWT.
- Develop the components and containers in AWT.
- Develop the GUI application using checkboxes, radio buttons, List Boxes etc.
- Construct different types of Layouts.

Activity:

Develop a client side module which contains checkboxes, text fields, text area, radio buttons etc.

Text Books:

1. The complete Reference Java, 8thedition, Herbert Schildt, TMH.
2. Programming in JAVA, Sachin Malhotra, Saurabh Choudary, Oxford.
3. Introduction to java programming, 7thedition by Y Daniel Liang, Pearson.

Reference Books:

1. Swing: Introduction, JFrame, JApplet, JPanel, Componets in Swings, Layout Managers in
2. Swings, JList and JScrollPane, Split Pane, JTabbedPane, JTree, JTable, Dialog Box.

Course Code		L	T	P	Credits
1004173203	VLSI DESIGN	3	1	0	3

Course Description:

Design the stick and layout diagrams for NMOS, PMOS & CMOS technologies.

Course Objectives:

The student will be able to

- Use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnections.
- Learn the various fabrication steps of IC and come across basic electrical properties of MOSFET.
- Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect and to verify the functionality, timing, power and parasitic effects.
- The concepts and techniques of modern integrated circuit design and testing (CMOS VLSI).
- Design static CMOS combinational and sequential logic at the transistor level, including mask layout.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe the fabrication process for MOS,CMOS and BICMOS technologies along with their electrical properties	Understanding	PO1,PO2
CO2	Outline the concepts of design rules during the layout design	Understanding	PO2,PO3,PO5
CO3	Model various scaling Models and factors and their effects on MOSFET parameters.	Apply	PO3,PO4
CO4	Examine various design issues of VLSI Circuits and illustrate FPGA Design	Analyze	PO3,PO4

UNIT – I

Introduction: Introduction to IC Technology, MOS and related VLSI Technology, IC production process, MOS and CMOS Fabrication processes, BiCMOS Technology, Comparison between CMOS and Bipolar technologies.

Basic Electrical Properties Of MOS and Bi-CMOS Circuits: Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans conductance, Output Conductance and Figure of Merit. The Pass transistor, NMOS Inverter, Pull-up to Pull-down Ratio for NMOS inverter driven by another NMOS inverter. Alternative forms of pull-up, The CMOS Inverter, MOS transistor circuit model, Bi-CMOS Inverter, Latch-up in CMOS circuits and BiCMOS Latch-up Susceptibility

Outcome: Understand the concepts of MOS,CMOS&BICMOS technologies for the layout design.

Activity/Event: Derive the expressions for V-I for EMOSFET & DMOSFET.

UNIT-II

MOS and Bi-CMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout, General observations on the Design rules, 2μm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2μm Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter.

Outcome: Apply the concepts of design rules during the layout design.

Activity/Event: Design the stick and layout diagrams of basic, universal, AOPI, OAI & special gates.

UNIT-III

Basic Circuit Concepts: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances, Fan-in and fan-out characteristics, Choice of layers, Transistor switches, Realization of gates using NMOS, PMOS and CMOS technologies.

Scaling Of MOS Circuits: Scaling models, Scaling factors for device Parameters, Limits due to sub threshold currents, current density limits on logic levels and supply voltage due to noise.

Outcome: How MODFET parameters affects the scaling of MOS circuits.

Activity/Event: Determine the sheet resistance, standard unit of capacitance and delays for different technologies.

UNIT-IV

Subsystem Design: Architectural issues, switch logic, Gate logic, examples of structured design, clocked sequential circuits, system considerations, general considerations of subsystem design processes, an illustration of design processes.

Outcome: Model & simulate digital VLSI systems using HDL and synthesize digital VLSI systems from RTL.

Activity/Event: Design the switch logic and gate logic circuits.

UNIT-V

VLSI Design Issues: VLSI Design issues and design trends, design process, design for testability, technology options, power calculations, package selection, clock mechanisms, mixed signal design, ASIC design flow, FPGA design flow, introduction to SoC design.

FPGA Design: Basic FPGA architecture, FPGA configuration, configuration modes, FPGA families, FPGA design examples-stack, queue and shift register implementation using VHDL.

Outcome: Understand the current trends in semiconductor technology & how it impacts scaling & performance.

Activity/Event: Excute different VHDL programs using front end design process.

Text Books:

1. Essentials of VLSI Circuits and Systems, Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 1st Edition, 2009.
2. VLSI Design Black Book, Dr. K.V.K.K. Prasad, Kattul Shyamala, Kogent Learning Solutions Inc. 1st Edition, 2012

Reference Books:

1. VLSI Design, A.Albert Raj & T.Latha,PHI Learning Private Limited,1st edition,2010.
2. VLSI Design, A.Shanthi and A.Kavita, New Age International Private Limited, 1st Edition 2006.

Course Code		L	T	P	Credits
1099173201	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3

Course Overview:

To develop and strengthen entrepreneurial quality and motivation in students. To impart basic Entrepreneurial skills and understandings to run a business efficiently and effectively.

Course Objectives: This course gives the

.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Understanding the Entrepreneurship	Understanding	PO:6, PO:8, PO:9
CO2	Understanding the Business Environment	Understanding	PO:6, PO:8, PO:9
CO3	Exposure on Industrial Policies	Understanding	PO:6, PO:8, PO:9
CO4	The Business plan Preparation	Analysis	PO:6, PO:8, PO:9, PO:11, PO:12
CO5	How to Launching of small business, management.	Understanding	PO:11, PO:12

Unit-I:

Entrepreneurial Competence:

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.

Outcome: Understanding the Entrepreneurship

Activity: Videos on Entrepreneurship

Unit-II:

Entrepreneurial Environment:

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services

Outcome: Understanding the Business Environment

Activity: Videos on Business Environment

Unit-III:

Industrial Policies:

Central and State Government Industrial Policies and Regulations - International Business.

Outcome: Exposure on Industrial Policies

Activity. Video

Unit-IV:

Business Plan Preparation:

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product -Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

Outcome: The Business plan Preparation

Activity/Event : preparing a business plan preparation

Unit-V:

Launching Of Small Business:

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection – Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.

Management Of Small Business:

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

Outcome: How to Launching of small business, management.

Activity/Event : Motivational Videos

Text Books:

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001.

References

1. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra ,2nd Edition 2005
2. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.
3. P.Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai -1997.
4. Arya Kumar. Entrepreneurship. Pearson. 2012
5. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning. 2012

Course code		L	T	P	Credits
1002174201	DIGITAL CONTROL SYSTEMS	3	1	0	3

Course Overview:

In recent years digital controllers have become popular due to their capability of accurately performing complex computations at high speeds and versatility in leading non linear control systems. In this context, this course focuses on the analysis and design of digital control systems.

Course Objectives:

- To understand the concepts of digital control systems and assemble various components associated with it. Advantages compared to the analog type.
- The theory of z–transformations and application for the mathematical analysis of digital control systems.
- To represent the discrete–time systems in state–space model and evaluation of state transition matrix.
- To examine the stability of the system using different tests.
- To study the conventional method of analyzing digital control systems in the w–plane.To study the design of state feedback control by "the pole placement method."

Course Outcomes:

- Modelling of Digital control Systems in frequency domain and time domain.
- Understand z–transformations and their role in the mathematical analysis of different systems
- Analyse stability criterion for digital systems
- Design of state feedback controller for Linear Discrete systems.

UNIT-I

Digital signal processing

Introduction to analog and digital control systems – Advantages of digital systems –examples – Signals and processing – Sample and hold devices – Sampling theorem- Frequency domain characteristics of zero order hold.

Unit-I Outcome: Knows the difference between analog and digital signals

Activity/Event on Unit-1: Reconstruction of signal

UNIT-II

Z–transformations

Z–Transforms – Theorems – Finding inverse z–transforms – Formulation of difference equations and solving – Block diagram representation – Pulse transfer functions and finding open loop and closed loop responses.

Unit-II Outcome: Relation Between Laplace and Z-Transformation

Activity/Event on Unit-II: Applying Z-Transforms for different signals

UNIT–III:

State space analysis

State Space Representation of discrete time systems – State transition matrix Discretization of

continuous – Time state equations –Concepts of controllability and observability – Tests

Unit-III Outcome:

- To represent the discrete–time systems in state–space model and evaluation of state transition matrix.

Activity/Event on Unit-III: Determine the controllability and observability of the systems

UNIT – IV:

Stability analysis

Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips – Stability criterion – Modified routh's stability criterion and jury's stability test.

Unit-IV Outcome:

To study the conventional method of analyzing digital control systems in the w–plane.

Activity/Event on Unit-IV:

examine the stability of the system using different tests.

UNIT – V:

Design of discrete–time control systems and state feedback controllers

Transient and steady state specifications – Design using frequency response in the w–plane for lag and led compensators – Root locus technique in the z–plane. Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula.

Unit-V Outcome: Design of state feedback control by "the pole placement method."

Activity/Event on Unit-V: Design a State Feedback Controller

Text Books:

1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn.
3. Signals & Systems- Narayan Iyer and K Satya Prasad, Cenage Pub.

Reference Books:

1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition.
2. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015
3. Signals and Systems – K Raja Rajeswari, B VisweswaraRao, PHI, 2009
4. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition, 2008.
5. Signals and Systems – T K Rawat , Oxford University press, 2011

Course Code		L	T	P	Credits
1002174202	**HVDC TRANSMISSION**	4	0	0	3

Preamble:

This course deals with the importance of HVDC Transmission system, analysis of HVDC converters, faults and protection, harmonics and filters. This also covers reactive power control

and converter control characteristics.

Course Objectives:

- To compare HVDC and AC transmission systems.
- To explain the operation of six pulse and twelve pulse converters and control reactive power.
- To discuss various converter faults and protection methods.
- To explain about AC harmonics and design filters.

Course Outcomes

After completing this Course, the student will be able to:

1. Compare HVDC and AC transmission system w.r.t. economical, technical and reliability aspects.
2. Analyze the six pulse and twelve pulse converter configurations and describe converter control characteristics and reactive power control in HVDC transmission system.
3. Distinguish various converter faults and protection methods in HVDC transmission system.
4. To calculate AC harmonics and design suitable filters to eliminate them.

UNIT – I:

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC & DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C. Transmission.

UNIT – II:

Analysis of HVDC Converters:

Choice of converter configuration – Effect of source inductance on the system -Graetz bridge –- analysis with grid control without overlap and with overlap for less than and more than 60 º, Equivalent circuit of converter- Cases of two 3 phase converters in star –star mode – their performance-characteristics of 6 pulse & 12 pulse converters

UNIT – III:

Converter & Reactive Power Control in HVDC:

Principle of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control – Starting and stopping of DC link - Power Control.

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies-sources of reactive power-AC Filters – shunt capacitors-synchronous condensers-Introduction to MTDC systems-Types of MTDC systems-series, parallel, ring systems

UNIT– IV:

Converter Fault & Protection:

Converter faults – protection against over current and over voltage in converter station – surge arresters –smoothing reactors – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference.

UNIT – V:

Harmonics & Design of Filters

Generation of Harmonics –Characteristics harmonics, calculation of AC Harmonics, Non-Characteristics harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics.
Types of AC filters, Design of Single tuned filters –Design of High pass filters

Text Books:

1. K. R. Padiyar, HVDC Power Transmission Systems: Technology and System Interactions, New Age International (P) Limited, and Publishers.

Reference Books:

1. J. Arrillaga, 'High voltage Direct Current Transmission', Peter Peregrinus Ltd., London, UK, 1983.
2. E.W. Kimbark, 'Direct current Transmission', Wiley& sons, NewYork,1971
3. E. Uhlmann, Power Transmission by Direct Current, B.S. Publication.
4. S. Kamakshaiah and V. Kamaraju, HVDC Transmission, Tata McGraw–Hill

Course Code		L	T	P	Credits
1002174203	ELECTRICAL DISTRIBUTION SYSTEMS	4	0	0	3

Course Overview:

This is an open elective course developed to cater the current needs of the Power System Distribution networks. This subject deals with the general concept of distribution system, substations and feeders as well as discusses distribution system analysis, protection and coordination, voltage control and power factor improvement.

Course Objectives:

To introduce basic knowledge about various types of distribution network systems and to calculate the voltage drops occurring in a distribution network and to study the distribution system protection and its coordination and also study the effect of compensation for power factor improvement.

Course Outcomes:

Students will be able to:

- To study different factors of Distribution system.
- To study and design the substations and distribution systems.
- To study the concepts of voltage drop and power loss& the effect of voltage control on distribution system.
- To study the distribution system protection and its coordination & the effect of compensation for power factor improvement.

UNIT – I:

General Concepts

Introduction to distribution systems, Load modeling and characteristics – Coincidence factor-Contribution factor loss factor – Relationship between the load factor and loss factor – Classification of loads (Residential, commercial, Agricultural and Industrial).

UNIT – II:

Substations

Location of substations**:** Rating of distribution substation – Service area with ‘n’ primary feeders – Benefits and methods of optimal location of substations..

Distribution Feeders

Design Considerations of distribution feeders**:** Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT – III:

System Analysis

Voltage drop and power–loss calculations**:** Derivation for voltage drop and power loss in lines – Uniformly distributed loads and non-uniformly distributed loads – Numerical problems.

Voltage Control

Voltage Control**:** Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems, introduction of AUFR (Automatic under Frequency Relays).

UNIT– IV:

Protection

Objectives of distribution system protection – Types of common faults and procedure for fault calculations for distribution system – Protective devices**:** Principle of operation of fuses-Circuit reclosures – Line sectionalizes and circuit breakers.

Coordination

Coordination of protective devices**:** General coordination procedure –Various types of coordinated operation of protective devices - Residual Current Circuit Breaker

UNIT – V:

Compensation for Power Factor Improvement

Capacitive compensation for power factor control – Different types of power capacitors –shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location – Numerical problems.

Text Books:

1. "Electric Power Distribution system, Engineering" – by Turan Gonen, McGraw–hill Book Company.

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
2. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4th edition, 1997.
3. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers.

Course Code	SMART GRID TECHNOLOGIES	L	T	P	Credits
1002174204		3	1	0	3

Course Overview:

This course deals with the Smart Grid concept, comparison between traditional electricity grid and Smart Grid, various Smart Grid Technologies, Microgrids and Distributed Energy Resources. It also discusses Power Quality Management in Smart Grid and Information & Communication Technology for Smart Grid.

Course Objectives:

- To understand the concept of smart grid and developments on smart grid.
- To understand smart grid technologies and hybrid electric vehicles.
- To have knowledge on smart substations, feeder automation and application for monitoring and protection.
- To study micro grids and distributed energy resources.
- To know power quality & ICT aspects of smart grid.

Course Outcomes:

At the end of the course, the students will be able to:

CO1: Explain the concept of Resilient and Self-Healing Grid.
CO2: Discuss Plug-in Hybrid Electric Vehicles (PHEVs) and the concept of Vehicle-to-Grid.
CO3: Describe Smart Substations, GIS, Smart Storage, WAMS and PMU.
CO4: Discuss Micro Grids (MGs) and Distributed Energy Resources (DERs) and also PQ issues with RES and also ICT for Smart Grid.

Unit-I:

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid**,** Smart Grid Initiatives.

Unit-I Outcome: Distinguish between Conventional Grid and Smart Grid

Activity/Event: List out various national and international initiatives of Smart Grid.

Unit-II:

Smart Grid Technologies: Part 1: Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation.

Unit-II Outcome: Discuss how real time pricing contributes to effective utility load management.

Activity/Event: List out various Smart Appliances and their details (rating, manufacturer, etc.)

Unit-III:

Smart Grid Technologies: Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phasor Measurement Unit (PMU).

Unit-III Outcome: Describe various Smart Storage Devices/Systems.

Activity/Event: Visit a nearby Pumped Hydro Power Plant and write a complete technical report on it.

Unit-IV:

Micro grids and Distributed Energy Resources: Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources.

Unit-IV Outcome: Explain protection and control of microgrid.

Activity/Event: Write a technical report on the capative power plant of Vizag Steel Power Plant.

Unit-V:

Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN).

Unit-V Outcome: What is Power Quality Audit? Explain AMI, HAN, NAN, WAN.

Activity/Event: List out various PQ Meters.

Text Books:

1. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama,"Smart Grid: Technology and Applications", John Wiley & Sons Ltd., 2012
2. James Momoh, "Smart Grid – Fundamentals of Design and Analysis ", John Wiley Inc., 2012
3. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
4. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press
5. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19
6. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
7. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
8. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press

Reference Books:

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press
3. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer
4. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication
5. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press

Course Code	FLEXIBLE ALTERNATING CURRENT	L	T	P	Credits

1002174205 TRANSMISSION SYSTEMS 3 1 0 3

Course Overview:

This course deals with the fundamental concepts, principles, analysis of different types of Flexible AC Transmission System Controllers (series, parallel, combined). It also discusses how FACTS Controllers are applied to solve important problems of power system like power flow control, voltage regulation, transient stability, voltage instability, power oscillation, etc.

Course Objectives:

Learning Objectives:
- To learn the basics of power flow control in transmission lines using FACTS controllers
- To explain the operation and control of voltage source converter.
- To understand the compensation methods to improve stability and reduce power oscillations of a power system.
- To learn the method of shunt compensation using static VAR compensators.
- To learn the methods of compensation using series compensators
- To explain the operation of Unified Power Flow Controller (UPFC).

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Explains power flow control in transmission lines using FACTS controllers.
CO2: Compare voltage sourced converter (VSC) and current sourced converter (CSC)
CO3: Analyze Shunt compensation methods to improve transient stability and reduce power oscillations in the transmission lines.
CO4: Discuss operation and control of SVC and STATCOM and describe series compensators and combined compensators used in enhancing the performance of transmission lines.

Unit-I:

Introduction to FACTS

Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high power devices – Voltage and current rating – Losses and speed of switching – Parameter trade–off devices.

Unit-I Outcome: Explain the basic types of FACTS controllers.

Activity/Event on Unit-1: List out different types FACTS Controllers installed in the world.

Unit-II:

Voltage source and Current source converters

Concept of voltage source converter (VSC) – Single phase bridge converter – Square–wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter– Three–phase current source converter – Comparison of current source converter with voltage source converter.

Unit-II Outcome: Explain operation and control of voltage source converter.

Activity/Event on Unit-II: Design and develop three phase VSC.

Unit-III:

Shunt Compensators–1

Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of

line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping.

Unit-III Outcome: Discuss Mid–point voltage regulation for line segmentation.

Activity/Event on Unit-III: Write a report on how FACTS Controllers have helped in power system performance enhancement in the world.

Unit-IV:

Shunt Compensators–2

Thyristor Switched Capacitor (TSC)–Thyristor Switched Capacitor – Thyristor Switched Reactor (TSC–TCR).

Static VAR compensator (SVC) and Static Compensator (STATCOM): The regulation and slope transfer function and dynamic performance – Transient stability enhancement and power oscillation damping– Operating point control and summary of compensation control.

Unit-IV Outcome: Summarize shunt compensation control.

Activity/Event on Unit-IV: Design and develop a prototype model of STATCOM and test it in the laboratory.

Unit-V:

Series Compensators

Static series compensators**:** Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements. GTO thyristor controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC).

Combined (Series-Parallel) Compensators

Schematic and basic operating principles of Unified Power Flow Controller (UPFC).– Application on transmission lines.

Unit-V Outcome: Discuss the principle of operation of TCSC and UPFC.

Activity/Event on Unit-V: Design and develop a prototype model of UPFC and test it in the laboratory..

Text Books:

1. N.G.Hingorani and L.Guygi, "Understanding FACTS", IEEE Press.Indian Edition is available:—Standard Publications, 2001.

Reference Books:

1. Yong Hue Song and Allan T Johns "Flexible ac transmission system (FACTS)" Edited by , Institution of Electrical Engineers, London.

2. R.Mohan Mathur and Rajiv k.Varma, 'Thyristor-based FACTS Controllers for Electrical Transmission Systems', Wiley.

Course Code		L	T	P	Credits
1002174206	POWER SYSTEM REFORMS	4	0	0	3

Course Overview:

This course introduces the concepts and issues of power system reforms and aims at computation of Available Transfer Capability (ATC), Congestion Management, Electricity Pricing, Ancillary services Management and Power system operation in competitive environment.

Course Objectives:

- To study fundamentals of power system deregulation and restructuring.
- To study available transfer capability.
- To study congestion management
- To study various electricity pricing.
- To study operation of power system in deregulated environment.
- To study importance of Ancillary services management.

Course Outcomes

At the end of the course, the student will be able to:

CO1: Explain the importance of power system deregulation and restructuring.
CO2: Compute ATC.
CO3: Describe transmission congestion management.
CO4: Compute electricity pricing and explain power system operation in deregulated environment and also discuss the importance of ancillary services.

Unit-I:

Over view of key issues in electric utilities Introduction – Restructuring models – Independent system operator (ISO) – Power Exchange – Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

UNIT – II:

OASIS: Open Access Same–Time Information System Structure of OASIS – Processing of Information – Transfer capability on OASIS – Definitions Transfer Capability Issues – ATC – TTC – TRM – CBM calculations – Methodologies to calculate ATC.

UNIT – III:

Congestion Management: Introduction to congestion management – Methods to relieve congestion

UNIT– IV:

Electricity Pricing: Introduction – Electricity price volatility electricity price indexes – Electrical and Electronics Engineering 209 Challenges to electricity pricing – Construction of forward price curves – Short–time price forecasting.

UNIT – V:

Ancillary Services Management: Introduction – Reactive power as an ancillary service – A review – Synchronous generators as ancillary service providers.

Text Books:

1. Kankar Bhattacharya, Math H.J. Boller, Jaap E.Daalder, 'Operation of Restructured Power System' Klum,er Academic Publisher – 2001
2. Mohammad Shahidehpour, and Muwaffaq alomoush, – "Restructured electrical Power systems" Marcel Dekker, Inc. 2001

Reference Books:

1. Loi Lei Lai; "Power system Restructuring and Deregulation", Jhon Wiley & Sons Ltd., England-2002.
2. Electrical Power Distribution Case studies from Distribution reform, upgrades and Management (DRUM) Program, by USAID/India, TMH-2012.

Course code **CONDITION MONITORING OF ELECTRICAL** **L** **T** **P** **Credits**

1002174207 EQUIPMENTS 3 1 0 3

Course Overview:

This course deals with condition monitoring of electrical equipment like transformer, rotating machines, insulation.

Course Objectives:

1. Explanation of failure pattern and failure analysis of transformer
2. Different methods to find life analysis of electrical equipment
3. Different methods to find the location of fault
4. Differentiation of ideal and fault response of equipment parts by using various analysis.

Course Outcomes:

After learning the course the students will be able to

1. Estimate the condition of various electrical installation based on Insulation status.
2. Implement condition monitoring plan for complete Electrical System
3. Identify amount of damage/deterioration in the Equipment
4. Check the mechanical stability of the electrical equipment

Unit-I:

Maintenance and Condition Monitoring:

Importance and necessity of maintenance, different maintenance strategies like Break down maintenance, planned maintenance and condition based maintenance. Planned and preventive maintenance of transformer, induction motor and alternators. Insulation stressing factors, insulation deterioration, polarization index, dielectric absorption ratio. Insulation ageing mechanisms, Insulation failure modes, Definition of terms, Concept of condition monitoring of electrical equipment. Overview of Advanced tools and techniques of condition monitoring, Condition monitoring by thermography.

Unit-I Outcome: Able to explain the different types of faults in insulation materials

Activity/Event on Unit-1:PPT presentation on any fault in insulation by students

UNIT –II:

Transformer Diagnostics Technique (Part-1)

Introduction, Transformer failure pattern and failure analysis, Aging of electrical Power infrastructure, Diagnostic method, Transformer oil paper insulation system, Remaining life analysis Conventional tests, Dissolved Gas Analysis, Gas Evolution in a Transformer, Key Gas method, IEEE Method, Gas Ratio Method, Fault Detectability using DGA, Combine Criteria for DGA Degree of Polymerization and Furan Analysis, Moisture analysis in Transformer Oil, Time domain Dielectric Response Methods, Polarization and depolarization current measurements, Frequency Domain Dielectric Frequency Response (DFR) Method, Introduction and Basic Philosophy, Advantages and Disadvantages of DFR measurement in Time and Frequency domain

Unit-II Outcome: Able to test the transformer by using different methods

Activity/Event on Unit-II:PPT presentation on any fault in transformer by students

UNIT –III:

Transformer Diagnostics Technique (Part-2)

Partial Discharge measurements, PD Measuring circuits, calibration, signature analysis, Indirect electrical measurement, UHF sensor and HF CT, Measurement of PD under DC, Acoustic Technique, Evolution, Principle, Overview of Acoustic Technique. Detection of Winding Displacements, Sweep Frequency Response Analysis, Basic features of SFRA response, connection methods, Transfer function features, FRA Test Types, Basics of FRA interpretation, Influence of winding parameters on FRA, Online FRA measurement OLTC and Bushing diagnostics, Accessories, Life Assessment and Refurbishment

Unit-III Outcome: Able to test the transformer by using different methods

Activity/Event on Unit-III:PPT presentation on any fault detection method in transformer by students

UNIT –IV:

Condition Monitoring of Rotating Electrical Machines

Introduction to motor condition monitoring, The need for monitoring, What and when to monitor, Construction, operation and failure modes of electrical machines, Structure of electrical machines and their types, Machine specification and failure modes, Failure sequence and effect on monitoring, Typical root causes and failure modes, General, Root causes, Failure modes

Temperature monitoring: Instrumentation requirement for Temperature measurement, Local temperature measurement, Hot-spot measurement and thermal images, Bulk measurement

Chemical monitoring: Insulation degradation, Factors that affect detection, Insulation degradation detection, Particulate detection: core monitors, Particulate detection: chemical analysis, Gas analysis off-line, Gas analysis on-line, Lubrication oil and bearing degradation.

Unit-IV Outcome: Able to explain the causes and failures of rotating machines

Activity/Event on Unit-IV:PPT presentation on any fault in rotating machine by students

UNIT –V

Mechanical faults and vibration monitoring

Identifying methods of Mechanical Faults with Motor Current Signature Analysis (MCSA), faults that can be detected with MCSA: Air-Gap Eccentricity, Broken Rotor Bars, Bearings Damage, Shorted Turns in Stator Windings, etc. ELCID test for stator, RSO test for rotor.

Vibration monitoring: Instrument required for Vibration measurement, Condition monitoring of rotating elements, Bearing response, Rolling element bearings, bearing geography, Bearing Monitoring techniques, Overall level monitoring, Frequency spectrum monitoring.

Unit-V Outcome: Able to explain mechanical faults in rotating machine

Activity/Event on Unit-V: PPT presentation on any mechanical fault in rotating machine by students

Reference Books:

1. Kulkarni S. V. and Khaparde S. A., " Transformer Engineering – Design, Technology and Diagnostics" Second Edition, CRC Press, NewYork
2. T. S. Ramu and H N Nagamani, "Partial Discharge Based Condition Monitoring of High Voltage Equipment" New Age International, NewDelhi
3. W. H. Tang and Q. H. Wu, "Condition Monitoring and Assessment of Power Transformers Using computation Intelligence", Springer, London2010
4. Peter Tavner, Li Ran, Jim Penmanand Howard Sedding, "Condition Monitoring of Rotating Electrical Machines", Published by The Institution of Engineering and Technology, London, United Kingdom,2008
5. Hamid A Toliyat, Subhasis Nandi, Seungdeog Choi, HomayounMeshgin-Kelk, " Electric Machines: Modeling, Condition Monitoring and Fault Diagnostics, CRCPress
6. Chakravorti Sivaji, DeyDebangshu, Chatterjee Biswendu, "Recent Trends in the Condition Monitoring of Transformers- Theory, Implementation and Analysis" Springer,2013
7. Greg C. Stone, Edward A. Boulter, Ian Culbert, Hussein Dhirani, "Electrical Insulation for Rotating Machines: Design, Evaluation, Aging,Testing, and Repair", IEEE Press Series on Power Engineering, A John Wiley & Sons, Inc., Publication,2004
8. R.E. James and Q. Su, "Condition Assessment of High Voltage Insulation in Power System Equipment", Published by The Institution of Engineering and Technology, London, United Kingdom, 2008

Course code		L	T	P	Credits
	INTERNSHIP				
1002174281		**0**	**0**	**0**	**12**

Internship: Internships help students to acquire in depth knowledge about a particular topic related to the program of study. Such extensive work is expected to create a platform for a job or further research in the chosen area. Interested students may opt for a full semester Internship during the fourth year second semester. Such students shall be exempted for equivalent theory course credits during that semester and the corresponding credits are awarded through the Internship. A self-study report, duly authorized by the industry supervisor / guide, shall be submitted at the end of the fourth year second semester. Internship report is evaluated for 400 marks in total. Internal assessment is done by the academic supervisor/guide for 100 marks based on the work and presentation of the internship report. The assessment for 300 marks is evaluated and awarded by a panel of members consisting of Head of the Department, Senior Faculty and Industry Expert.

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Course code		L	T	P	Credits
	TECHNICAL SEMINAR				
1002174251		**0**	**3**	**0**	**2**

Technical Seminar: For Technical seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his/her understanding over the topic, and submit to the department, which shall be evaluated by the Departmental Committee consisting of Head of the Department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for seminar.

Course code		L	T	P	Credits
1002174261	COMPREHENSIVE VIVA	0	0	0	2

Comprehensive Viva: The Comprehensive Viva aims to assess the students' understanding in various subjects he / she studied during the B.Tech course of study. Comprehensive Viva is conducted for a total of 50 marks. It shall be conducted in IV Year II Semester. The Comprehensive Viva–Voce will be conducted by a Committee consisting of Head of the Department, & senior faculty members of the Department.

Course code		L	T	P	Credits
1002174231	MAIN PROJECT	0	0	0	10

Main Project: Out of total 200 marks for the project work, 80 marks shall be for Internal Evaluation and 120 marks for the external assessment. The Internal Evaluation shall be on the basis of two mid-term project reviews conducted during the progress of the project. The End Semester Examination (Viva-Voce) shall be conducted by the committee consists of an External Examiner, Head of the Department (internal examiner) and a senior faculty of the Department. The evaluation of project work shall be conducted at the end of the IV year.